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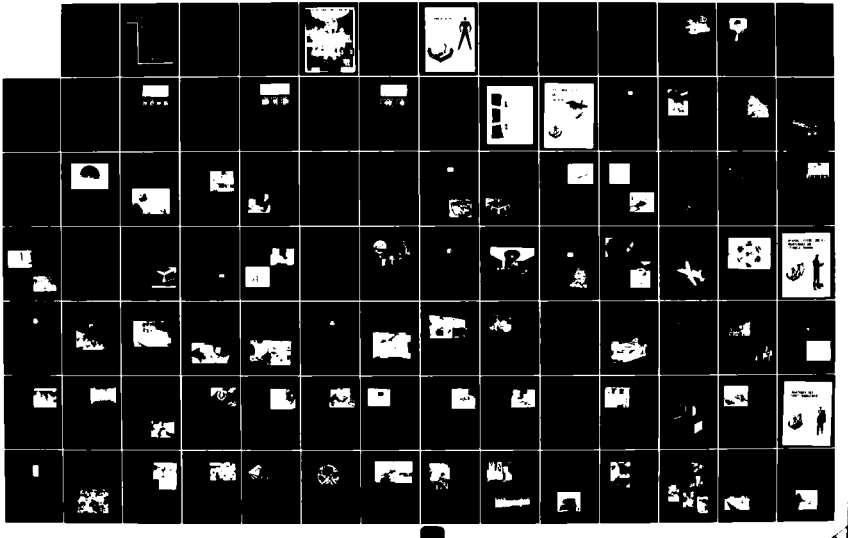

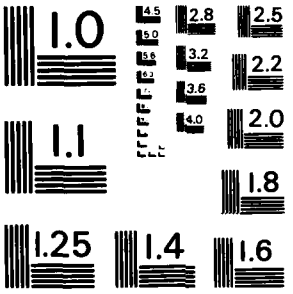

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AIR FORCE HUMAN RESOURCES LABORATORY

AIR FORCE HUMAN RESOURCES LABORATORY ANNUAL REPORT – FISCAL YEAR 1982

Edited by

Ruth M. Buescher

APPLICATIONS AND LIAISON OFFICE
Brooks Air Force Base, Texas 78235

June 1983

Final Technical Paper

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This paper presents the Air Force Human Resources Laboratory (AFHRL) mission, and descriptions of its research and development (R&D) thrusts. Fiscal Year 1982 technical achievements and on-going R&D are organized under each thrust area. It further outlines AFHRL organizational structure, the functions of its divisions and staff offices, and available resources. It lists publications and presentations by Laboratory personnel during Fiscal Year 1982.

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AIR FORCE HUMAN RESOURCES LABORATORY

AIR FORCE HUMAN RESOURCES LABORATORY

A Designated Organizational Element of the Air Force Systems Command

RONALD W. TERRY
Colonel, USAF
Commander

EARL A. ALLUISI
Chief Scientist

ACKNOWLEDGEMENTS

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and other anonymous Air Force photographers

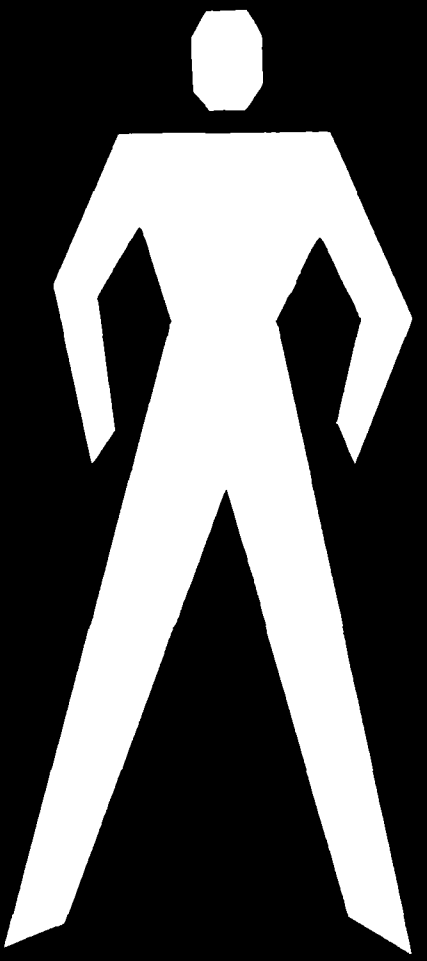
NOTICES

CONTACTS: A directory of AFHRL headquarters staff personnel and division chiefs is provided on the inside back cover. Points of contact are also given for each technical achievement and for each ongoing research and development project.

NOTE: The findings in this report are not to be construed as an official Department of the Air Force position unless so designated by other authorized documents.

Department of the Air Force
AIR FORCE HUMAN RESOURCES LABORATORY
Brooks Air Force Base, Texas 78235

ANNUAL REPORT



FY 82

AFHRL TECHNICAL PAPER 83-15

MISSION

Principal AFSC Organization for Planning & Executing USAF Exploratory & Advanced Development Programs in:

- Manpower and Personnel
- Education and Training
- Simulation and Training Devices
- Logistics and *Human Factors

*Group Aspects--Individual Aspects of Human Factors Engineering RDT&E Assigned the Aerospace Medical Research Laboratory

ORIGIN

In the late 1960s, the Secretary of the Air Force and the Air Force Chief of Staff felt it necessary to redefine the Air Force's R&D efforts in the related areas of personnel and training. In August 1967, the augmented Psychology and Social Sciences Panel, USAF Scientific Advisory Board (SAB), conducted a study concerning such R&D work. In its report, the SAB developed certain standards needed for a successful program: The requirement for managers of these R&D efforts to possess and display a keen interest in the entire program; the proper allocation of sufficient funding commensurate to the work being accomplished; the acquisition and retention of well-trained and highly qualified people; the recognition that the "human factor" involved in personnel and training R&D makes it a unique entity that cannot be compared to the subjects of hardware R&D in the Air Force's respective physical science laboratories; the need for R&D functions to be geographically close to the organizations that most effectively applied the results of that R&D work; and finally, the need for a proper balance between finding solutions to current problems and the achievement of long-range R&D goals. On July 1, 1968, the Air Force Human Resources Laboratory (AFHRL) was established with an organizational structure that has allowed it to effectively carry out its mission over the last 15 years.

AFHRL ANNUAL REPORT FY 82

CONTENTS

The heart and soul
of any military force are people....
No military force,
no matter how sophisticated its equipment,
will be any better than its people....

CASPAR W. WEINBERGER
Secretary of Defense

MESSAGE FROM THE COMMANDER

Colonel Ronald W. Terry

The United States Air Force (USAF) completed 35 years as a separate military service during 1982. The men and women of the USAF continue, as they have from the very beginning, to provide dedicated service to our nation and the defense of freedom around the world. The Air Force Human Resources Laboratory (AFHRL) is proud to play its part as the struggle for freedom continues. Our R&D programs focus on the central themes of USAF readiness and combat success.

Today, the USAF is armed with the most advanced and complex weapon systems ever devised. Well trained and highly motivated people operate and maintain these systems. Yet, as we look into the 80's and beyond, developments that are at once exciting and promising, yet disquieting and challenging, appear to dominate the horizon. We face monumental changes in the way people work, handle information, and fight wars. The industrial revolution is being replaced by the information age. Travel beyond our atmosphere is a reality. Every aspect of air power is changing rapidly. The events and conditions of the wars that threaten us now, and of those we may have to fight in the future, forge an inseparable link between the airman and the scientist, the historian and the futurist.

AFHRL is the USAF agency responsible for R&D in four areas: Manpower and personnel, education and training, simulation and training devices, and logistics and human factors. Our R&D program is organized into three thrusts integrated across the four areas. The program is designed to sustain USAF leadership in the manpower, personnel, and training technologies. Its goal is to improve human performance and the interface of people with the systems and subsystems they operate and maintain.

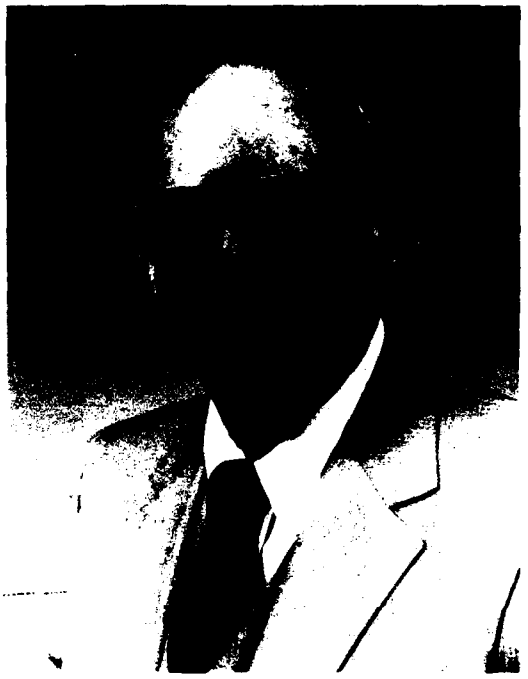
The products of the Laboratory's three R&D thrusts will contribute in increasingly critical ways to the USAF's capabilities to sustain the high states of readiness that ensure combat success now and into the future whatever the challenges of change may pose.

Looking back over my years as AFHRL Commander, I am proud of our accomplishments. Beginning in 1978, we thoroughly reassessed the directions and goals of the Laboratory. This reassessment led to a major restructuring of the R&D program in 1979. The need for organizational changes became apparent as the new program evolved, and the indicated realignments of the Laboratory's resources were completed by 1980. Now the Laboratory's R&D program is clearly articulated in terms of the thrusts portrayed throughout this report.

This annual report highlights--for our sponsors, customers, and others--some of the features of our organization, programs, technical achievements, and on-going R&D projects of fiscal year 1982. Most of our projects carry over several years, with each years's efforts providing another piece in the overall mosaic of the total program. We invite you to visit with us through this report, and to become better acquainted with our R&D programs and products.

RONALD W. TERRY, Colonel, USAF
Commander

CHIEF SCIENTIST'S REPORT



Dr. Earl A. Alluisi

AFHRL is developing technology for Air Force use in acquiring, training, and managing the highly capable personnel force necessary to ensure that Air Force weapon systems are operated and supported so well that combat success is assured. The Laboratory's R&D program is organized into three technical thrusts as follows:

(1) The Air Combat Tactics and Training thrust provides engineering technology for flight simulators and training technology for proper use of these simulators in acquiring and maintaining combat flying skills. The aim is to provide the means to train highly effective aircrews capable of performing on their first combat missions at the levels of combat veterans who have already successfully flown several combat missions.

(2) The Weapon Systems Logistics, Maintenance, and Technical Training thrust is developing technology for technical and maintenance training, and for weapon systems support. The technology permits integration of manpower, training, and logistics considerations into weapon systems design and acquisition to increase the combat supportability of fielded systems. The thrust also aims to provide advanced training technology using computer-based instructional systems as well as technology to improve the performance of maintenance and support units.

(3) The Manpower and Force Management thrust provides technology for effective acquisition, distribution, and management of the personnel force. This means making the best person-job matches possible--a difficult task considering the size of the Air Force (566,000 uniformed personnel in 1982), and the impacts of economic, social, and political factors on manpower availability.

Each of the three thrusts is described in greater detail on the pages that follow. Each is managed principally by one of the Laboratory's three R&D divisions located near major Air Force users of the technologies developed within the thrusts.

These collocations of R&D efforts with the users of the R&D products, and the resultant frequent

contacts between R&D and user personnel, serve at least two practical goals: (1) Ensuring that there is an on-going, technically sound, R&D program and (2) ensuring that the program is adaptive, relevant, beneficial, and cost effective within the context of its products being usable to increase the ease and probability of USAF combat success.

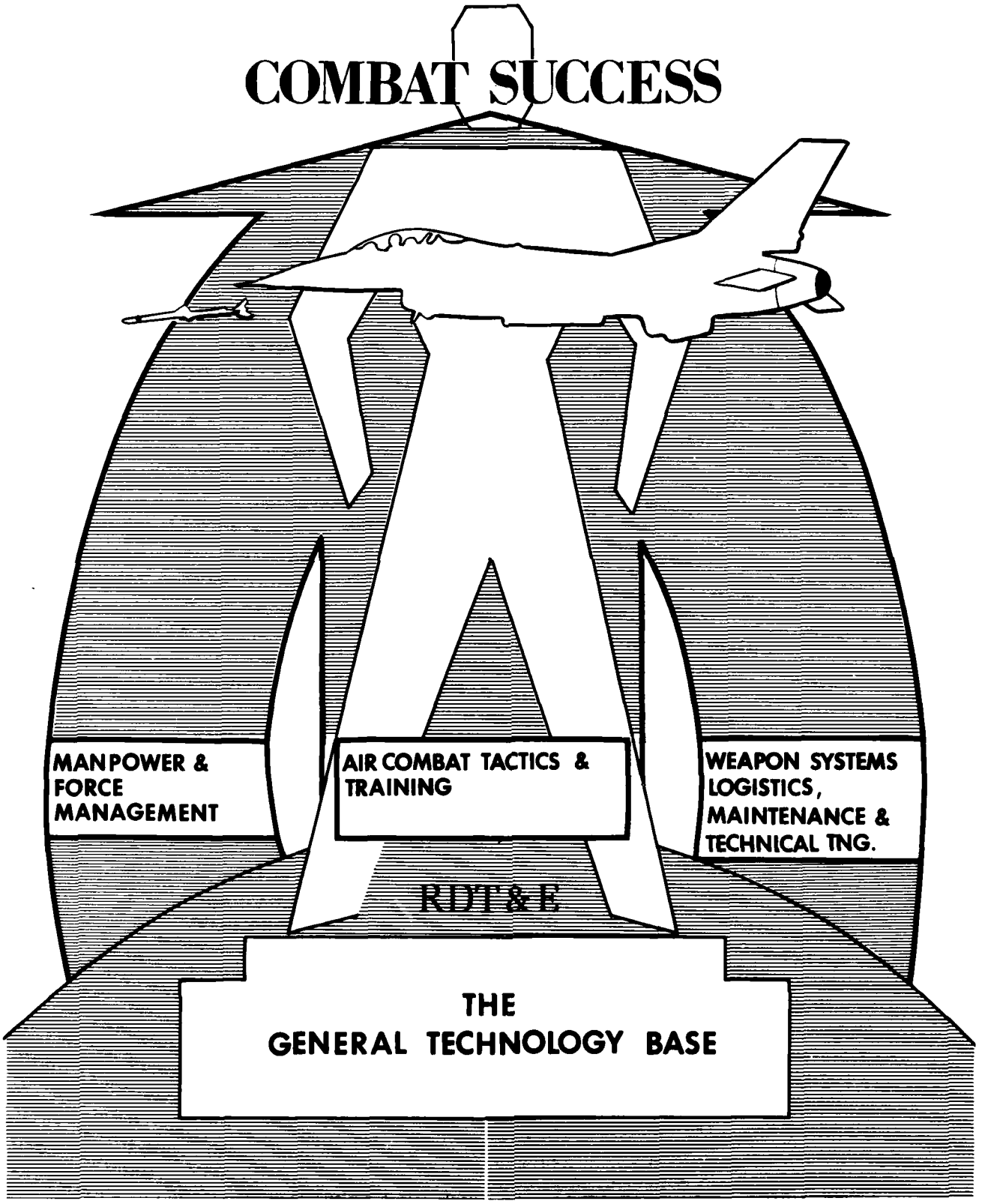
Technical Evaluations. In addition to the numerous management reviews of the Laboratory during FY 82, there was one major technical review aimed to assess the quality of the program and its technical soundness. This technical review, now scheduled as an annual event, is conducted through the AFHRL Technical Advisory Board (TAB), which consists of the Technical Directors of the three R&D divisions, the Chief Scientist as chair, and a secretary. For each of the three thrusts, the TAB is assisted by a different Research Advisory Panel (RAP), each of which consists of three scientists of international repute in relevant substantive areas from outside the Department of Defense, and by External Reviewers (ERs) who are counterparts from the corresponding laboratories of the other Services. The TAB technical reviews are based on week-long meetings with division personnel, including especially the task scientists actually conducting or monitoring the work, in each of the three specific thrusts. The FY82 reviews, only the "second round" of TAB technical reviews, were judged successful, but additional technical (as contrasted with management) details were cited as being desirable in all three cases. More importantly, the benefits of the continuing progress being made to integrate the program within each of the three thrusts were manifestly evident, and the foundation strengthened for further integration among them.

Technical Status of the Air Combat Tactics and Training Thrust. The Laboratory's engineering R&D on flight simulation continued in a single integrated subthrust on Engagement Simulation Technology. The Advanced Simulator for Pilot Training (ASPT) image generator, though limited, can be used to develop parts of a "Universal Data Base" for future advanced visual systems, and current R&D has demonstrated wartime scenario training even though current ASPT image generation capacity is inadequate to "decorate" an entire combat area. The use of "artificial" visual stimuli for cuing, e.g., inverted cones to cue low-level flight, represents a good use of existing capability. It was recommended that the division devote greater efforts to automate transition of visual information from other sources to an image generator. The new engineering subthrust to demonstrate the technological feasibility of a Combat Mission Trainer (CMT) continued. The CMT concept is based upon application of helmet-mounted display (fiber optics, miniature cathode ray tubes, or laser projectors), advanced computer image generation, and microlinkage technologies to demonstrate a relatively low-cost, transportable device suitable for combat mission training and practice at the Squadron or Wing level. Technical risks have been identified and evaluated, with parallel exploratory or advanced development efforts scheduled in the areas of highest risk as cooperative or joint efforts with other R&D agencies. The absence of a detailed and credible plan for R&D in the sensor simulation area was cited as a recognizable gap in the program. The behavioral R&D side of the thrust is represented primarily in the Air Combat Training Systems subthrust which, although improved and strengthened during the year, remains less technically sound than desired, at least in part due to resource constraints. In the performance measurement area, progress is being made through an advanced development contractual effort, but the in-house level of effort remains extremely modest. Technically sound advances are being made in the electronic combat and bombing accuracy areas. It was recommended that resources continue to be focused on the development of measures of individual performance, and more progress should be made in the areas of crew/team coordination and performance measurement. The emerging thrust on Operational Unit Training has taken the direction of R&D on combat skills training strategies that employ special function trainers (SFTs) based on small, inexpensive microcomputer instrumentation. In general, the program was adjudged technically sound and well balanced, given the user needs as stated in relevant documents (Requests for Personnel Research and Technical Needs) and the expertise available. The technical risks involved are largely related to the lack of depth in personnel resources and the thinness with which the personnel are spread across program areas.

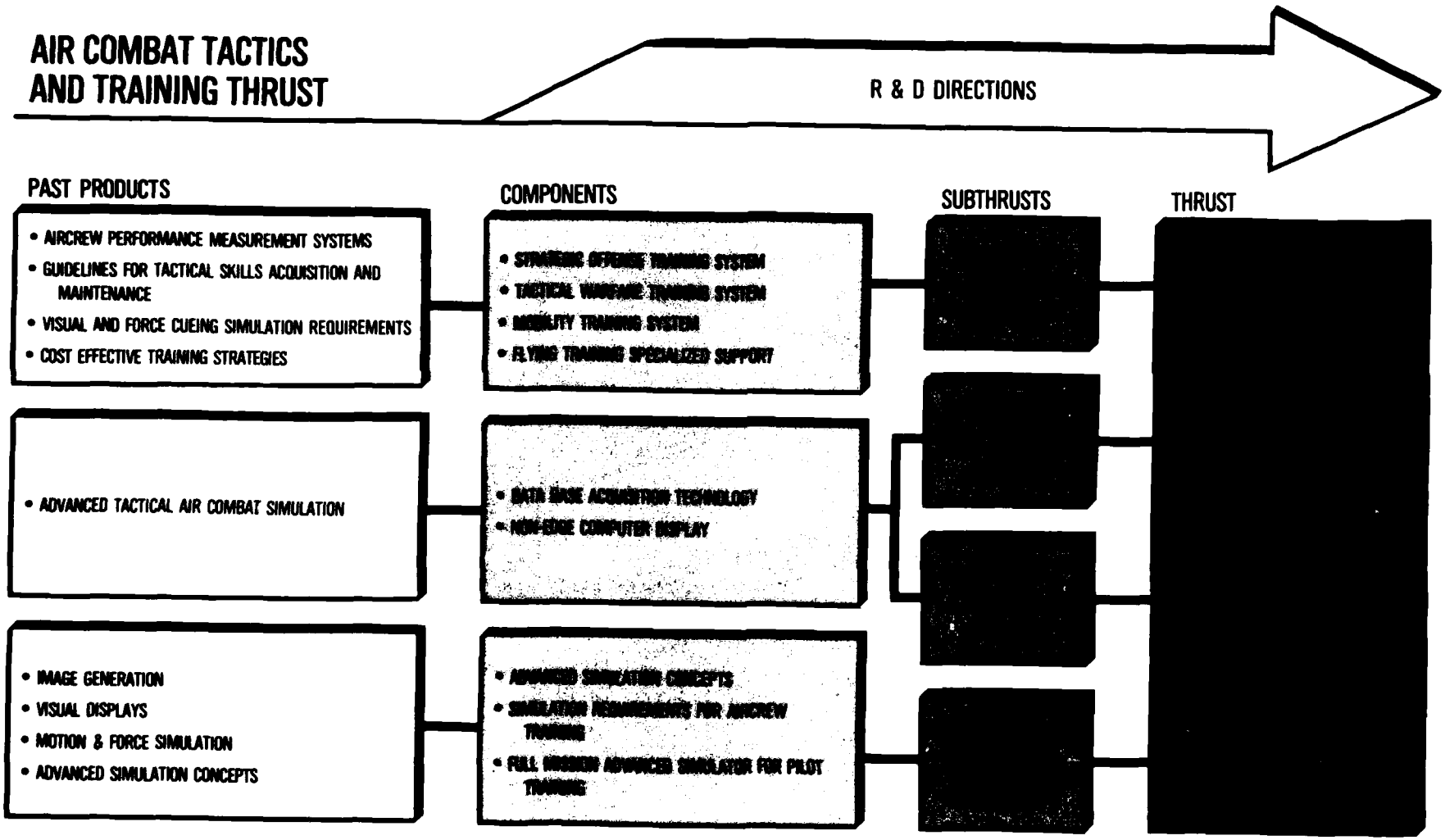
Technical Status of the Weapon Systems Logistics, Maintenance, and Technical Training Thrust. FY82 represents the first full year of R&D on this completely restructured thrust. The emerging Crew, Group, Team, and Unit (CGTU) Performance and Training Systems subthrust continues to employ the command and control system as an environment (or "carrier signal") for its R&D, with the potential of contributing substantially to success in many combat scenarios. Major progress has been made in the subthrust's articulation of operational systems, procedures and problems, as well as in identifying the "players," being recognized as responsible R&D team-mates, and structuring a technically sound R&D program. Resources allocated to this subthrust are currently insufficient for a program of the scope that is technically adequate to address the problem areas in an effective and timely manner. The Combat Logistics Technologies subthrust was evolved from sound experience in manpower and human-resource factors in design and weapon systems acquisition, and battle-damage repair studies. Similarly, the Technical and Maintenance Training Systems subthrust was developed out of prior R&D in maintenance aiding and performance enhancement, maintenance training simulation, and computer-based instructional systems in technical training. The needs in this thrust area remain clear--to provide a technology base for the delivery of skilled personnel and materiel to the operating Major Commands of the Air Force. This thrust continues to emphasize issues of applicability to combat operational support, but the R&D program plans have been rescoped downward to match more closely the level of available or anticipated resources. Within the limitations set by the resources, the program is adjudged to be technically sound in general, and focused to obtain a good return on investment with an acceptable balance of technical risk and potential payoff.

Technical Status of the Manpower and Force Management Thrust. The development of Enlisted and Officer Force Acquisition and Distribution Systems continued as the major subthrust, with the Enlisted and Officer Force Management Systems subthrust emerging in somewhat greater detail during FY 82. This thrust is primarily responsive to Air Force personnel system operations in the current or peacetime environment, but it also now includes planned R&D on issues applicable to combat operations. With the support of the Air Force Office of Scientific Research, data-collection facilities were established, and data collection begun in basic areas such as interest measurement, information processing, cognitive skills, and learning. The aim is to rejuvenate and expand the technology for selection, classification, training, assignment, retraining, retention, and force management generally--a mature technology that has otherwise had considerable refinement, but very little real expansion since World War II--with the integration of coordinate technology advancements in other areas (such as computers and cognitive psychology). In this area, as in the other areas of this thrust, the program was adjudged to be well planned and designed, and of high technical quality. However, the Division was cautioned that both the quality and effective scope of its program could be endanged by too-rapid expansion. Care should be exercised to ensure that in our enthusiams the program is not extended beyond the practical capabilities of the resources actually available. Additionally, the Division was encouraged to extend the well-established model of using measures of cognitive abilities to predict achievement in early career training, and rather to investigate other models and measures of factors that have major impacts on sustained on-the-job performances (especially, combat performances).

General Comments. An annual report is written at one point in time. It presents a static picture of a very dynamic technical program--a program which is, in the last analysis, the very substance of the Laboratory. The directions of the program are to the true scientist even more important than its current status. The evaluation is clear on this point--the directions as currently set are proper: To develop and apply the technology base in order to increase the probability and ease of combat success.


COMBAT SUCCESS
MANPOWER & FORCE MANAGEMENT
AIR COMBAT TACTICS & TRAINING
WEAPON SYSTEMS LOGISTICS, MAINTENANCE & TECHNICAL TNG.
RDT&E
THE GENERAL TECHNOLOGY BASE

AIR COMBAT TACTICS AND TRAINING THRUST



AFHRL THRUSTS

General Description

The Laboratory's FY82 R&D program was divided among three thrusts: (a) Air Combat Tactics and Training, (b) Weapon Systems Logistics, Maintenance, and Technical Training, and (c) Manpower and Force Management. Each thrust was managed through a Laboratory R&D Division: (a) The Operations Training Division (AFHRL/OT), (b) The Logistics and Technical Training Division (AFHRL/LR), and (c) The Manpower and Personnel Division (AFHRL/MO), respectively.

The subthrusts and components of the thrusts have been defined with certain of them still in the "emerging" stage. The "architectures," "roadmaps," or "R&D agendas" that are employed to describe all three levels--thrust, subthrust, and component--are dynamic rather than static. They may be expected to change somewhat from year to year to show validly the identification of both near-term and long-term objectives, the planned transfer of technologies and products where appropriate, and the approach employed to develop the technologies and systems desired for enhancement of combat success.

General descriptions of the thrusts are given below and on subsequent pages. Diagrams portraying the respective thrusts are also provided. These diagrams are employed with highlighting in later sections to aid in identification of the parts of the R&D program being reported.

AIR COMBAT TACTICS AND TRAINING THRUST

The primary objective of this thrust is an Air Combat Tactics and Training Technology that identifies and demonstrates in cost-effectiveness terms alternative training strategies and training equipment capabilities for use in obtaining, improving and maintaining the skills and combat effectiveness of USAF aircrew members. The thrust consists of four subthrusts: (a) Air Combat Training Systems, (b) Operational Unit Training Systems, (c) Combat Mission Trainer, and (d) Engagement Simulation Technology. The first and last subthrusts are ongoing, whereas the middle two are only now emerging R&D programs.

The objective of Air Combat Training Systems subthrust is to provide a technology base for training high-level aircrew performance skills through use of simulated combat environments. Current R&D focuses on the development of training strategies and equipment requirements for use in ordnance delivery on tactical targets using wartime tactics in a realistically modelled combat arena.

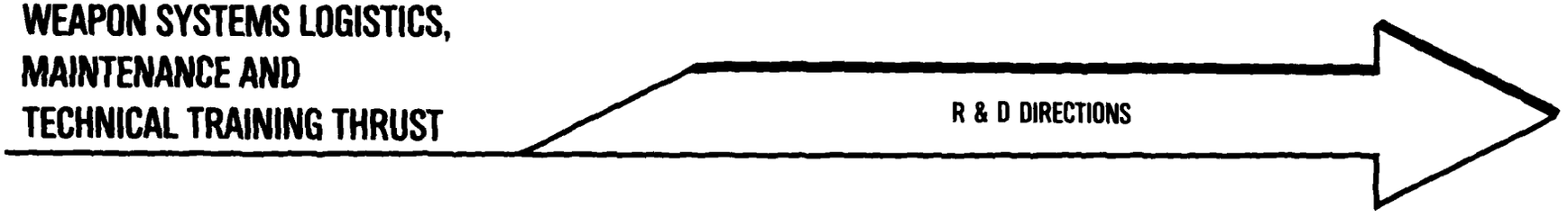
The Operational Unit Training Systems subthrust has as its objective the integration of operationally applicable findings concerning aircrew training into on-going unit training programs to improve both efficiency in training and the effectiveness of operational capabilities. It will integrate the full range of training-delivery capabilities from microcomputer-based desk-top procedural trainers to full field-of-view full mission simulators.

The Combat Mission Trainer subthrust, a cooperative effort with the Aerospace Medical Research Laboratory, has as its objective the development of a relatively low-cost, transportable device suitable for air-to-air and air-to-surface combat mission training at the Squadron level. Fiber-optics, helmet-mounted displays, advanced computer image generation, and computer microlinkage technologies will be used in its design.

The Engagement Simulation Technology is focused on the development of mission simulator components and techniques that provide greater training capability. It includes development of advanced computer image generation technology, as well as projection and display technologies to provide full field-of-view visual scenes for use in simulators.

In the near term, the products of this thrust are providing the equipment and training technologies necessary to teach basic combat skills and tactics. In the longer term, this thrust will increasingly address the training of those combat skills required to be successful in specific combat areas and to function effectively as a member of a coordinated combat team. The benefits of R&D success in this thrust will be increased mission readiness for operational aircrews.

WEAPON SYSTEMS LOGISTICS, MAINTENANCE AND TECHNICAL TRAINING THRUST



PAST PRODUCTS	COMPONENTS	SUBTHRUSTS	THRUST
• FUNCTIONALLY INTEGRATED SYSTEMS TRAINER (GUNSHIP) • 3D GRAPHICS FOR WEAPON DIRECTOR TRAINING	• CREW, GROUP, TEAM, AND UNIT PERFORMANCE TECHNOLOGY • CREW, GROUP, TEAM, AND UNIT TRAINING SYSTEMS FOR COMMAND AND CONTROL		
• COORDINATED LOGISTICS RESOURCE PLANNING • LIFE CYCLE COSTING • LOGISTICS COMPOSITE MODEL • REPAIR OF BATTLE DAMAGE • PROCEDURALIZED TROUBLESHOOTING AIDS • JOB GUIDE MANUALS	• ACQUISITION LOGISTICS METHODS • LOGISTICS FOR COMBAT MAINTENANCE • MAINTENANCE DIAGNOSTIC ERROR REDUCTION • AUTOMATED TECHNICAL DATA		
• SPECIFICATIONS AND FIDELITY REQUIREMENTS FOR SIMULATORS • COMPUTER BASED TRAINING MANAGEMENT SYSTEMS • *RESOURCE SCHEDULING SYSTEMS*	• MAINTENANCE SIMULATION • INTEGRATED TRAINING SYSTEM • COMPUTER BASED INSTRUCTION TECHNOLOGY TRANSFER		

WEAPON SYSTEMS LOGISTICS, MAINTENANCE, AND TECHNICAL TRAINING THRUST

The primary objective of this thrust is a Weapon Systems Logistics, Maintenance, and Technical Training Technology to ensure effective and efficient support of Air Force operations. This support includes logistics, material, and human resources. Special attention is devoted to maintenance, and to the supportability of new weapon systems. Also included as an objective is the technology to ensure effective team performance in ground-based systems. The thrust consists of three interrelated subthrusts: (a) Crew, Group, Team, and Unit (CGTU) Performance and Training Systems, (b) Combat Logistics Technologies, and (c) Technical and Maintenance Training Systems.

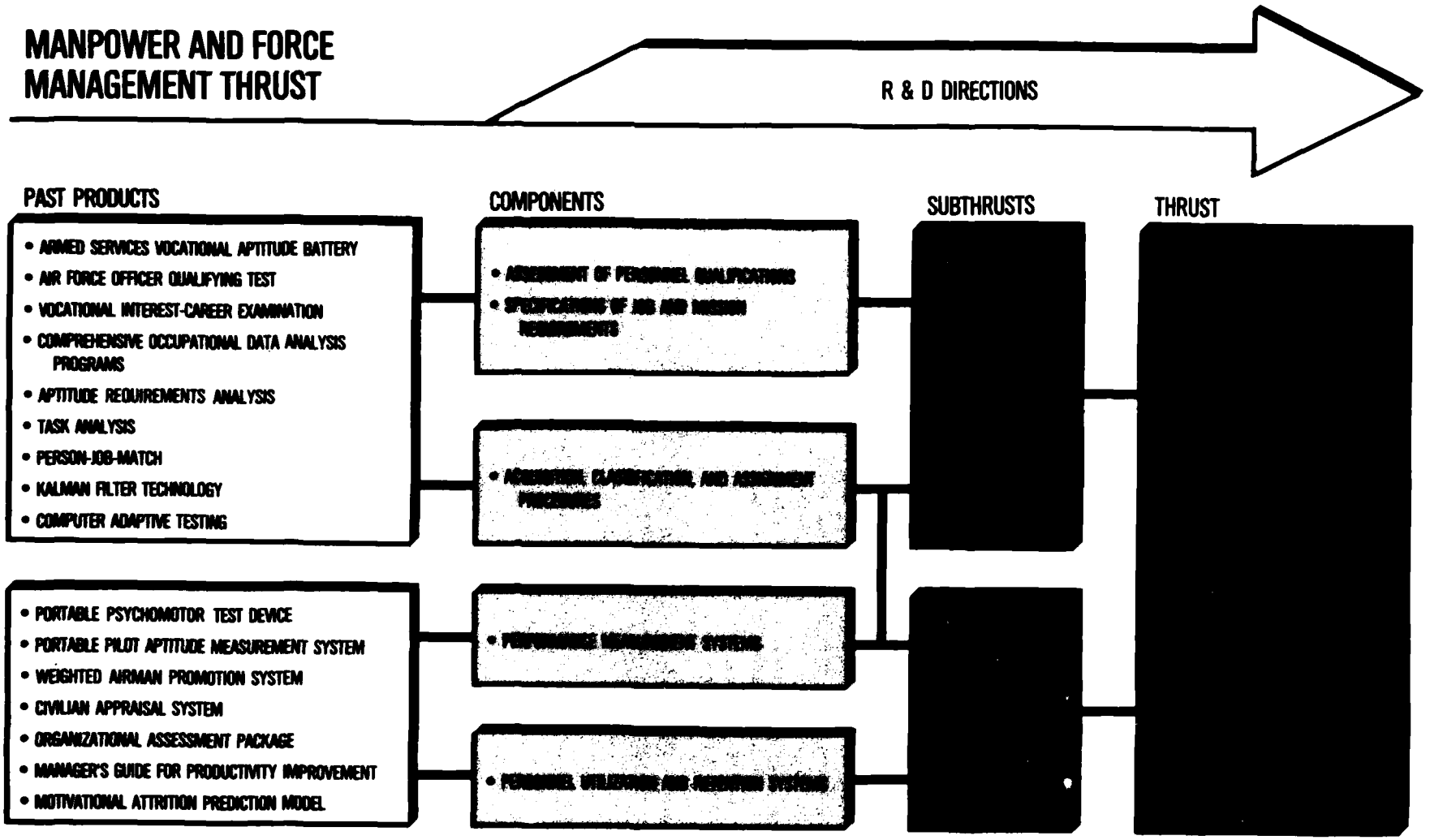
The emerging CGTU Performance and Training Systems subthrust is aimed at improving the performance of non-flying crews, groups, teams, and units. Special attention is being given to teams involved in command and control systems because of the pressing current needs for improvements in those systems.

The on-going Combat Logistics Technologies subthrust pertains especially to the logistics aspects of Air Force weapon systems. It includes four components: One to develop the technology for the integrated logistics system of new weapon systems; another to provide the technology to ensure effective logistics support for combat maintenance; and the remaining two to provide means for improving the performance of maintenance.

The Technical and Maintenance Training Systems subthrust pertains primarily to technical training with special attention to the training of maintenance personnel. Its components include simulators for maintenance training, a system for on-the-job-training delivery and management, and more extensive transfer of the technology for computer-based instructional systems developed by the Air Force.

The R&D investment represented by this thrust promises unusually high payoff. The potential to reduce costs and increase weapon systems supportability is high because this area of technology is quite underdeveloped and initial big-step improvements can be made. The subthrusts, as well as most of their components, have been the subject of unusual high-level interest. Special scientific and operational study groups have stressed the need for increased R&D in this area.

MANPOWER AND FORCE MANAGEMENT THRUST



MANPOWER AND FORCE MANAGEMENT THRUST

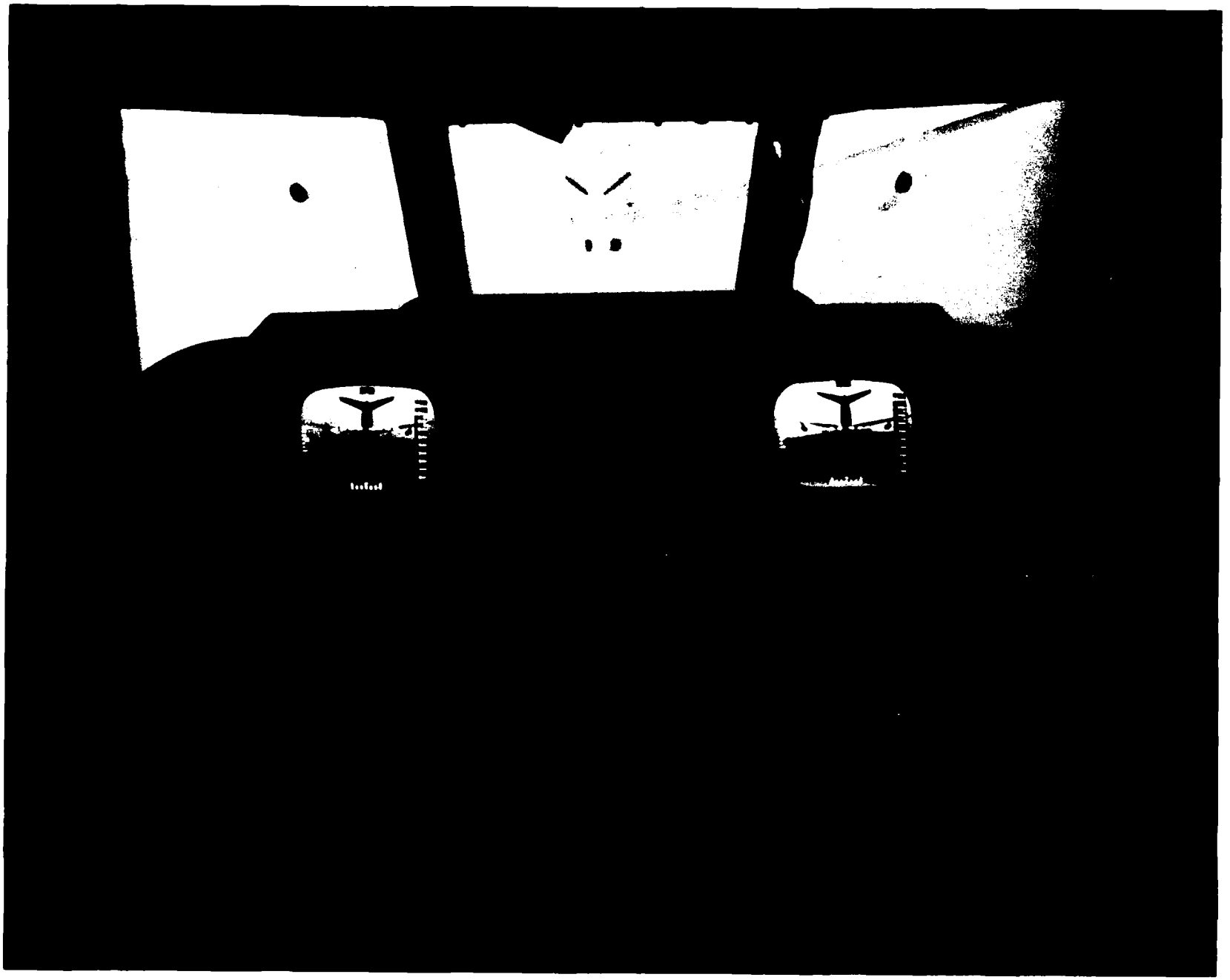
The primary objective of this thrust is a Force Acquisition and Management Technology based on management tools, procedures, and associated technologies that foster more effective use of personnel resources by: (a) improving selection and assignment methodologies, (b) establishing appropriate job requirements for Air Force specialties, (c) structuring and maintaining a workforce with the required aptitudes, experience, interests, and motivation to meet operational commitments both in peacetime and wartime environments, and (d) establishing comprehensive skills management programs to improve personnel utilization and productivity. These technologies are applicable to the recruitment and selection of personnel motivated for Air Force service, the assignment of personnel to jobs compatible with their aptitudes, interests, and experiences, and the establishment of effective reenlistment/career assignment programs. This thrust consists of two on-going subthrusts: Force Acquisition and Distribution Systems, and Force Management Systems.

The Force Acquisition and Distribution Systems subthrust is to provide advanced computer-based personnel management tools for use in the acquisition, initial assignment, and distribution of uniformed Air Force personnel. These tools will permit increased precision in recruitment, selection, classification, and assignment of Air Force personnel. The development of computer-assisted Force Acquisition and Distribution Systems will provide the Air Force with a variety of alternatives to force-manning compatible with various manpower supply scenarios, and will help to ensure that the available pool of talent is optimally employed, with personnel resources allocated to maximize the return on personnel investments.

The Force Management Systems subthrust is to provide devices, models, procedures, and strategies to improve evaluation of job performance, career motivation, retention, job satisfaction, and both individual and unit productivity, and to establish effective career assignment programs.

The products of this thrust include technologies that (a) improve the efficiency and economy of personnel acquisition, (b) ensure optimum classification and assignment of first-term and career personnel, (c) provide an accurate evaluation of individuals best qualified for Air Force service, (d) facilitate movement between specialties to correct manning imbalances, and (e) provide prototype systems for assessing the performance of Air Force personnel, both uniformed and civilian.

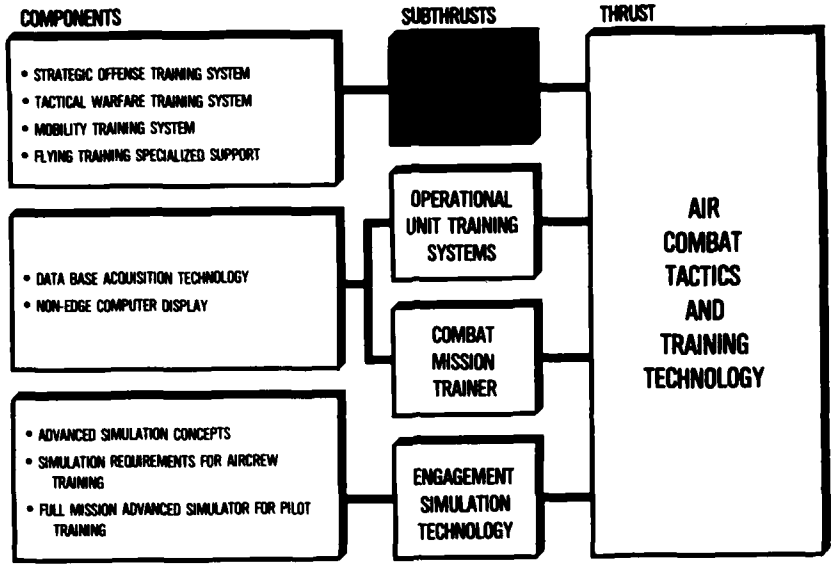
The longer-term benefits obtainable with the technologies being developed include (a) improving the capability and accuracy of matching an individual's aptitudes and abilities with Air Force job requirements, (b) increasing the flexibility and validity of testing by extending tests into new aptitude and non-aptitude domains, as well as computer-based methods such as computer-adaptive testing, (c) reducing attrition, (d) identifying and forecasting potential critical problems of manpower supply in time to propose remedial-action alternatives, (e) improving job satisfaction, productivity, and retention, and (f) developing on-the-job performance criteria for validation of selection devices and training syllabi.



AIR COMBAT TACTICS AND TRAINING

AF HUMAN RESOURCES LABORATORY

AIR COMBAT TACTICS AND TRAINING THRUST



AIR COMBAT TRAINING SYSTEMS **TECHNICAL ACHIEVEMENTS**

Title: **Derivative Fighter Training Considerations**

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Description: At the request of the F-16 Systems Program Office, AFHRL provided a broad "front end" look at some of the potential training considerations/problems associated with the F-16E aircraft. Because the study did not focus on an evaluation of specific cockpit technologies, observations are not specific to the F-16E, but apply equally well to most advanced fighter aircraft. Central to the discussion are the projected flying hour/sortie requirements (on the order of 200-plus sorties per 6-month period) needed to support continuation training in the areas of air-to-air and air-to-ground. Aside from the economic concerns associated with such a substantial flying hour program, a major concern centers about the ability of a pilot to perform required navigational and targeting tasks in high workload, low level, night flight environment characterized by high density, air defense threats. The performance data that were reviewed suggested that basic flight control tasks (e.g., use of defensive countermeasures and electronic countermeasures) central to aircrew survival may be significantly degraded by the simultaneou requirement to perform target detection/ recognition tasks at altitudes below 500 feet. In moving from 500 feet to 200 feet an order of magnitude in pilot task loading is perceived to occur. Data from studies conducted on the Advanced Simulator for Pilot Training (ASPT) under simulated high threat conditions have suggested that situational awareness under such conditions is a significant aircrew problem. Consideration was also given to new and emerging training system technologies. Among those mentioned were the use of light-attenuating devices for simulating night viewing conditions, the use of onboard simulation techniques, and the use of computerized threat simulation techniques to supplement training currently done on conventional electronic combat ranges.

Utilization: The information obtained in this study clearly indicates the training problems

ASPT F-16 Cockpit

expected to accompany the next generation fighter aircraft with its low level night attack mission. The information will be used by the Tactical Air Command in further assessing the "do-ability" and "supportability" of the low-level night attack mission. This information provides point of departure for AFHRL work in the training R&D work involving Low Altitude Night Targeting Infrared Navigator.

Benefits: This work provides human performance and training information for decision makers regarding the next generation fighter aircraft. Within this context, the message is simply that, "aircraft do not win wars by themselves." Any manned, operator-intensive system will be only as "unconstrained" in its operation as its crew is unconstrained by the training system that prepares them for the effective employment of that system.

Title: **TAC BRAWLER: Use of Engagement Simulation Methods for Identifying Aircrew Training Device Requirements**

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Description: Earlier work using the TAC BRAWLER model addressed the relationship of visual system resolution and target contrast to training effectiveness. These relationships were identified within the context of one-versus-one (1v1) and two-versus-one air-to-air engagements. Additional work was performed which isolated tradeoffs between field-of-view and resolution for visual systems utilizing small, high resolution insets within larger, lower resolution backgrounds. Work within the past year addressed the impact of visual system transport delays associated with current generation head-slaved, helmet-mounted display systems. Data relating variations in this design parameter to pilot performance were essentially unavailable at the time of the study. Consequently, predictions about the training effectiveness of such helmet-mounted display systems have been difficult to make. Transport delays of 0, 52, 100, and 173 msec were studied for 1v1 and two-versus-two (2v2) air combat engagements. The effects of transport delay on pilot-tracking performance (line of sight error, error in judging range, speed error as a percentage of actual speed, error in judgement of aspect angle, and transverse velocity error), as well as on measures of combat effectiveness (number of missile and/or gun shots taken, number of times on opponent's tail, and total time on opponent's tail), were studied. The data for 1v1 gun engagements (2v2 not yet analyzed) showed a clear dependence of tracking (gun engagements) upon transport delay for all measures used. In terms of measures of combat effectiveness, transport delay showed a significant effect on the number of shots taken. For 2v2 engagements when missile shots were constrained to rear hemisphere only (to increase requirement for aircraft maneuvering), the same relationship was observed. Generalizations from these data

are understandably constrained by their dependence on assumptions concerning pattern of head movement, pilot tracking model, pilot ability to "measure" certain accuracies, and pilot confidence in these "measurements." Although tracking errors were shown to be an increasing function of transport delay, meaningful differences between the 52 msec and 173 msec were difficult to discern. Thus, while the various components of pilot tracking performance in the TAC BRAWLER model showed clear sensitivities to variations in visual system transport delay and while measures of combat effectiveness were also in some instances sensitive to these manipulations, it remains difficult to establish final design requirements.

Utilization: These data have provided the Simulator Systems Program Office with the only information available about the relationship between pilot behavior and visual system transport delay. The nature of the suggested functional relationship between these variables makes it difficult to establish design criteria/limits for acceptable transport delays but does suggest that, across the range of delays representative of current helmet-mounted display systems, little change is to be expected in the performances examined in the present study.

Benefit: The use of engagement simulation models, such as TAC BRAWLER, for purposes such as this study represents a significant cost-effective alternative to the traditional flight test approach. In the present instance, it is inconceivable how flight test data could even have been acquired. Neither was it feasible to collect such data in a flight simulator due to the unavailability of hardware to implement the helmet-mounted configurations being investigated.

Title: **Tactical Air Warfare Training Simulation**

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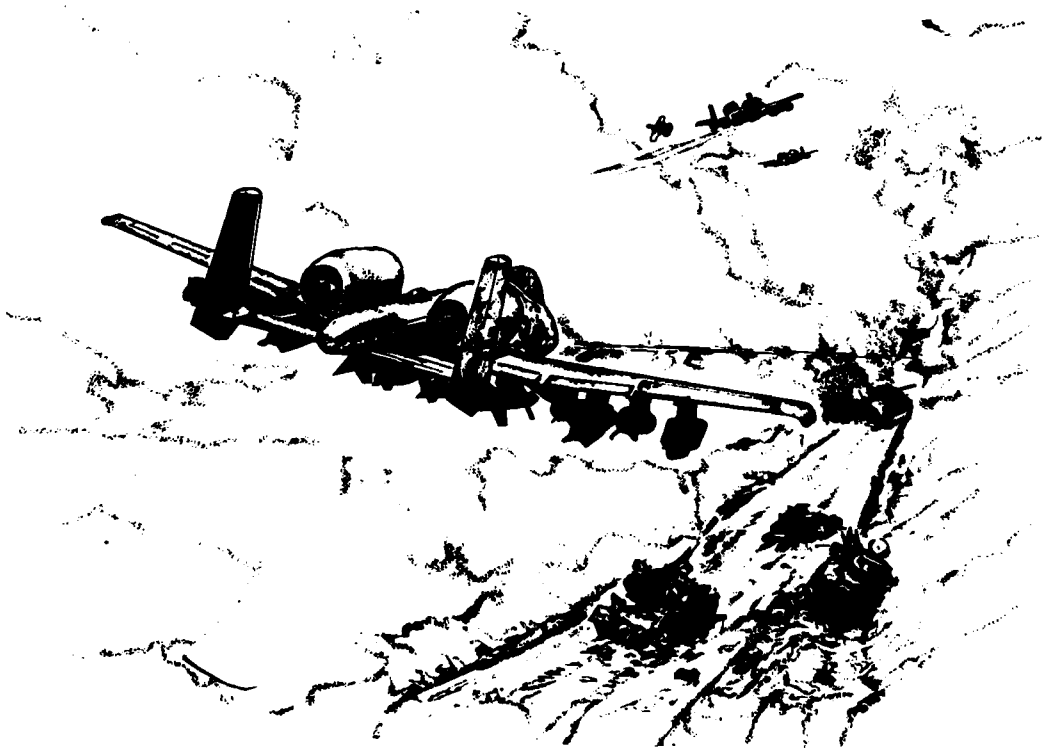
A-10 Warfare Simulation

Description: The Red Flag Transfer of Training Study which used the A-10 configuration of the Advanced Simulator for Pilot Training (ASPT) represented a major technical achievement in the past year. In providing empirical training effectiveness data, the experiment served to broaden the range of applications of the ASPT as a "testbed" for conducting research into tactical aircrew training and performance. With respect to its continued use for tactical training R&D, the ASPT has two major functions. First, as an aircrew training device testbed, the type of work exemplified by the Red Flag study can be transitioned to the eventual evaluation of the visual system technology project. Second, ASPT can be used as a tactics development and tactics verification testbed. An example of this latter application will be a joint study conducted with the Army to determine the impact of directed energy threats on the close air support aircrew

missions. ASPT in this mode of operation represents an excellent use of current simulation technology to assess the impact of future threats on the modern battlefield. Through the interactive threat environment in ASPT, AFHRL will also evaluate, under actual man-in-the-loop conditions, threat defeat logics to be used in future computerized threat simulations. Not only will the ASPT make it possible to assess the needs of future aircrew threat systems, but it can also provide guidelines for major procurement decisions regarding current threat training systems. Current work that AFHRL is conducting with the Air Force Armament Division at Eglin AFB will provide valuable training effectiveness data for the instrumentation of conventional electronic combat training range systems as well as such novel alternatives as the On-Board Electronic Warfare System.

Utilization: Data from the Red Flag transfer-of-training study suggest that simulators, properly configured for training, may impact aircrew survivability by as much as 20 percent (or more) in actual combat. AFHRL R&D in the area of electronic combat training effectiveness will have significant impact on aircrew survivability on the modern battlefield. The ASPT continues to be a critial resource for this on-going work both in the areas of assessing the training effectivness of alternative technologies as well as providing an invaluable glimpse of the performance of today's pilot on the expected battlefield of tomorrow.

Benefits: The ASPT with its current ability to conduct real-time, man-in-the-loop simulations of high threat environments, is providing a critical R&D resource not only to the Air Force, but also to those segments of DoD where data collected on the ASPT can have far reaching implications for the effectiveness of all DoD forces, both ground-based as well as airborne.



A-10 Close Air Support

Title: **Red Flag Transfer of Training Study**

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Description: Mission qualified A-10 aircraft pilots rehearsed close air support and battlefield interdiction missions under high threat conditions in the Advanced Simulator for Pilot Training (ASPT). Pilots were required to effectively integrate offensive and defensive performances within a threat environment representative of that found at the Forward Edge of the Battle Area (FEBA). Operating within a full field-of-view, monochromatic, computer-generated visual system, pilots visually engaged multiple arrays of tank-type targets defended by surface-to-air missile and antiaircraft artillery threat systems. Pilots were able to practice the use of defensive maneuvering, as well as chaff, against the fully interactive threat. Substantial gains in performance were shown in the simulator. Following the training in the ASPT, pilots in an experimental group proceeded to Nellis AFB where they participated in a 2-week tactical training exercise called Red Flag. Their actual range performances during the Red Flag exercise were compared to the performances of pilots in a control group who did not receive the simulator training in the ASPT. The data clearly showed that pilots who received the simulator training in the ASPT survived a significantly higher proportion of total Red Flag sorties flown than did those pilots who did not receive the simulator training. These data provide empirical data to support the claim that tactical training in a flight simulator can transfer to the operational environment and that such training can result in a significant increase in aircrew survivability.

Utilization: These data argue strongly not only for the potential impact of simulator training on improved aircrew survivability in combat but also for the importance of improved training, in general, in the area of electronic combat. As such, the results of this study provide the Air Force with a clear example of the need for improved training in this area and a suggestion for at least one way in which such a need may be satisfied. It is also important to note that the enhancements performed on the ASPT for this study have resulted in devices having a significantly improved potential for aircrew tactics training research and development (R&D). This improved capability for R&D will provide the basis for subsequent work in the area of electronic combat training effectiveness and aircrew tactics and threat assessment.

Benefits: The data collected in the Red Flag transfer-of-training study suggest that flight simulators configured similarly to the ASPT might result in as much as a 20 percent improvement in aircrew survivability for missions of the type addressed by this study. Potential improvements in performance of this magnitude argue that training may, indeed, be a significant force multiplier.

Title: **Three-Dimensional Visual Information Processing with a Binocular Helmet-Mounted Display**

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Description: A study has been completed to investigate the efficacy of a binocular helmet-mounted display (HMD) to provide usable stereopsis in a dynamic, simulated aerial refueling situation. A major Air Force need for existing and future operational systems is to present visual information in a manner that provides operators with accurate data about three-dimensional space. This is especially true in flight operations and flying training environments when the perception of depth is particularly critical. Existing visual displays of flight simulation training devices are totally dependent on the use of pictorial cues to present the perception of depth. Stereoscopic images result when two slightly disparate figures are presented independently to each eye. Current technology permits this to be done dynamically using

Stereopsis Research Using the 40-Degree Helmet Mounted Display

computer image generation. The A-10 configuration of the Advanced Simulator for Pilot Training (ASPT) was used in this study. Subjects wore the HMD and judged distances behind a KC-135 refueling tanker. Twelve subjects participated: six of these were shown a biocular display (same picture to each eye) and six saw a binocular display (slightly disparate left eye/ right eye views). The subjects did not actually fly the simulator. The A-10 was flown automatically from 440 feet behind the tanker and the subjects estimated when they were at 200, 100, 50 and 25 feet.

Utilization: The study results clearly indicated that the subjects learned to make accurate judgments about depth when using either the biocular or the binocular displays. This can be attributed to the pictorial and kinetic depth cues provided by the dynamic tanker model. Questionnaire responses of the subjects indicated that pictorial and kinetic cues were primary, independent of viewing condition. Observation of the data, however, showed that all binocular mean error scores were smaller than the biocular group scores. Post hoc Mann-Whitney U tests were performed between the groups at each distance. Only the comparison at 25 feet was significant ($U = 0$; $p < .001$).

Benefits: This study demonstrated that stereoscopic displays can provide usable depth information in a simulated aerial refueling situation. This should be viewed as the first step in the systematic investigation of the potential application of three-dimensional imaging for future training display systems.

AIR COMBAT TRAINING SYSTEMS

Title: **Assessment of Workload and Prediction of Performance by Combined Psychophysiological and Behavioral Techniques**

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Description: Physiological measures of pilot attention and workload are being developed. These measures will ultimately be used in conjunction with behavioral measures of pilot attention and task difficulty in order to optimally structure flight simulation training programs and equipment. One initial objective has been to establish laboratory procedures for handling the large quantities of data involved in psychophysiological research and ensure that all components of the computer laboratory were functioning properly. The variables of heart rate, skin conductance, respiration rate, pulse transit time, cortical evoked potentials, and eye movement have not been investigated simultaneously in previous research. A second major objective of this study is to investigate the interrelationships of these variables with each other and with performance on behavioral information processing tasks. A simplified laboratory flight simulation provides the behavioral task that is being used to study the various physiological variables. Heart rate, skin conductance, respiration rate, and pulse transit time are being studied as indicators of autonomic arousal. The cortical evoked potentials are related to attentional state and the complexity of stimuli emulation environment. This R&D effort is being co-monitored by the Air Force Human Resources Laboratory and the USAF School of Aerospace Medicine, Aerospace Medical Division.

Utilization: The measures of arousal (heart rate, skin conductance, respiration rate) reflect, in a gross sense, the degree of subject involvement in

In-Simulator Psychophysiological Measurement

the task. Also, both the early and late components of the cortical evoked response vary with task difficulty and performance. Assessment of human performance has become more difficult as the complexity of man-machine systems has increased. The point has been reached where behavioral research must step beyond the limits imposed by quantifying behavior in terms of motor responses only. Psychophysiological assessment of the internal state of the operator shows promise of providing the tools to take this step. By combining behavioral and psychophysiological assessments, a more comprehensive profile of human performance should emerge. This should permit a greater understanding of the conditions under which performance deteriorates and should point to training techniques and training equipment configurations that will maximize pilot performance.

Title: **Pilot Performance and Stress**

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Description: Biochemical measures of pilot stress were taken in conjunction with Undergraduate Pilot Training and A-10 aircraft surface attack training. The results established (a) that there is a consistent relationship between instructor pilot techniques and student pilot stress, (b) that stress incident to A-10 surface attack simulator training is not significantly different from stress observed in the aircraft, (c) that the establishment of competence in both simulator and aircraft tasks is associated with measurable changes in biochemical substrates, and (d) that experienced pilots exhibit a pronounced stress response when exposed to high threat/high workload tactical simulator scenarios.

Biochemical measures of stress and attention were taken following in-flight emergencies and precautionaries in T-37 and T-38 aircraft. Biochemical data are being analyzed using high pressure gas chromatography. Also, a second line of research is examining variation in biochemical response over the course of Undergraduate Pilot Training. The USAF School of Aerospace Medicine, Aerospace Medical Division, is co-monitoring this project with AFHRL.

Utilization: These results provide validation of the effectiveness of advanced simulation training for eliciting realistic stress levels.

Computer and Visual Feedback Display

Title: **Pilot's Eye Movement Patterns and Scanning Algorithms**

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Description: Eye movement metrics are being utilized to explore visual processes associated with target tracking and visual scanning strategies. Also, the utility of eye movement metrics for flight simulation applications, as a training tool, and for visual display/imagery evaluation purposes, will be investigated.

Utilization: This research will provide data pertinent to the application of eye movement metrics in a flight simulator environment.

AIR COMBAT TRAINING SYSTEMS

Title: **Energy Management Decision Making**

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Description: Pilots' ability to make vehicle control decisions is being investigated. The decision process of interest involves timing of turns, acceleration, etc. as opposed to fine control inputs such as stick and throttle inputs. The experimental task is a Flight Decision-Making Assessment Task (FDAT). In FDAT, given the situation of an airplane frozen in altitude, the subject is required to handle a vehicle through a series of discrete moves. Like an airplane, the FDAT vehicle is susceptible to speed/acceleration loss due to parasite and induced drag. This timing, of course, changes, and unloaded acceleration is critical to good task performance. The relation between FDAT performance and flying capability has been investigated. Individuals who are fighter-attack-reconnaissance (FAR) qualified evidence FDAT performance that is superior to that of non-FAR individuals.

Flight Decision-Making System

This superior performance is a result of a greater ability to execute correctly timed turns and to maintain maneuvering energy.

Utilization: The results of this effort will be used for identifying pilot skills and abilities and for development of non-real-time training aids.

Title: **Pilot Memory Structure**

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Description: A multi-dimensional scaling approach is being applied to investigate pilots' mental organization of flight-related information. Experiential factors have been found to have a significant effect on the way pilots organize flight-related information in memory. The pilots having the most experience have a more efficient and economical organizational schema than do less experienced pilots. Particular flying experience also has an effect on mental structure. Research currently in progress is investigating alternative frameworks for measuring and describing memory structure. The development of conceptual structure during Undergraduate Pilot Training is also being studied.

Utilization: The results of this research will be employed in developing methodologies for assessing pilots' knowledge and understanding of particular flying tasks. It will also impact the structure and evaluation of training programs and has human factors implications for device design.

Title: **Advanced Instructional Features in Aircrew Training Devices: Utility and Utilization Patterns**

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Description: The Aircrew Training Device (ATD) is not merely a flight simulator. It is also equipped with sophisticated hardware and software capabilities that permit an instructor pilot (IP) to control, monitor, and record flight simulation training sessions. These capabilities, known as advanced instructional features (AIFs) reflect the primary ATD role as a flight trainer. AIFs are costly to implement, especially those features that require the development of complex software. In order to justify these costs, several questions concerning the utility and utilization of AIFs must be answered. How frequently and easily are AIFs used? Are IPs adequately trained to use AIFs? Do AIFs have significant training value? Answers to these questions will be obtained through a survey of approximately 150 simulator IPs from the principal Tactical Air Command (TAC) ATDs. (Military Airlift Command and Strategic Air Command IPs will be surveyed during the next phase of this project, which will begin in FY 1983.)

Utilization: Preliminary results of the survey indicate that IPs receive minimal training in the use of AIFs and that most features are rarely used. Indeed, many IPs are unaware that particular features are even available. Although several AIFs were judged to have significant value in replacement and/or continuation training, it is clear that IPs will need to be educated in their effective use. The rationale for conducting the survey is to provide a data base that will be helpful both in defining the requirements for future ATD procurements and in developing subsequent ATD training programs.

Title: **Aircrew Training Management Information System**

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Description: The objective of this effort is to develop and evaluate a microcomputer-based Aircrew Training Management Information System (ATMIS) for the Tactical Air Command (TAC). Unlike many previous R&D efforts that were concerned with the development and validation of aircrew performance measures, the present effort is concerned with the management and use of those measures for training purposes. ATMIS will be implemented in three phases over the next two fiscal years. The first phase, which is nearly complete, comprises a review of computer-based training management systems; a detailed front-end analysis of a selected aircrew training program (i.e., the F-15 B-course conducted by the 405 Tactical Training Wing at Luke AFB); and prototype design, development, and demonstration. During subsequent phases, the ATMIS will be implemented at a selected training wing for a trial period. Pending a successful evaluation, a plan for command-wide implementation will be developed.

Utilization: The purpose of this effort is to use the existing TAC microcomputer capability to document, process, and provide summary reports of the data obtained on each student pilot during F-15 training. The data include mission/mission element grades awarded during simulator and aircraft training sorties, weapons data obtained from analyses of gun camera records, academic scores, and the results of mandatory proficiency checks. By documenting TAC combat effectiveness, ATMIS will provide information that can be used to help TAC aircrew personnel improve their combat capability and to help TAC training managers identify aircrew training requirements and develop optimal training programs.

Title: **Instructor/Operator Station Design**

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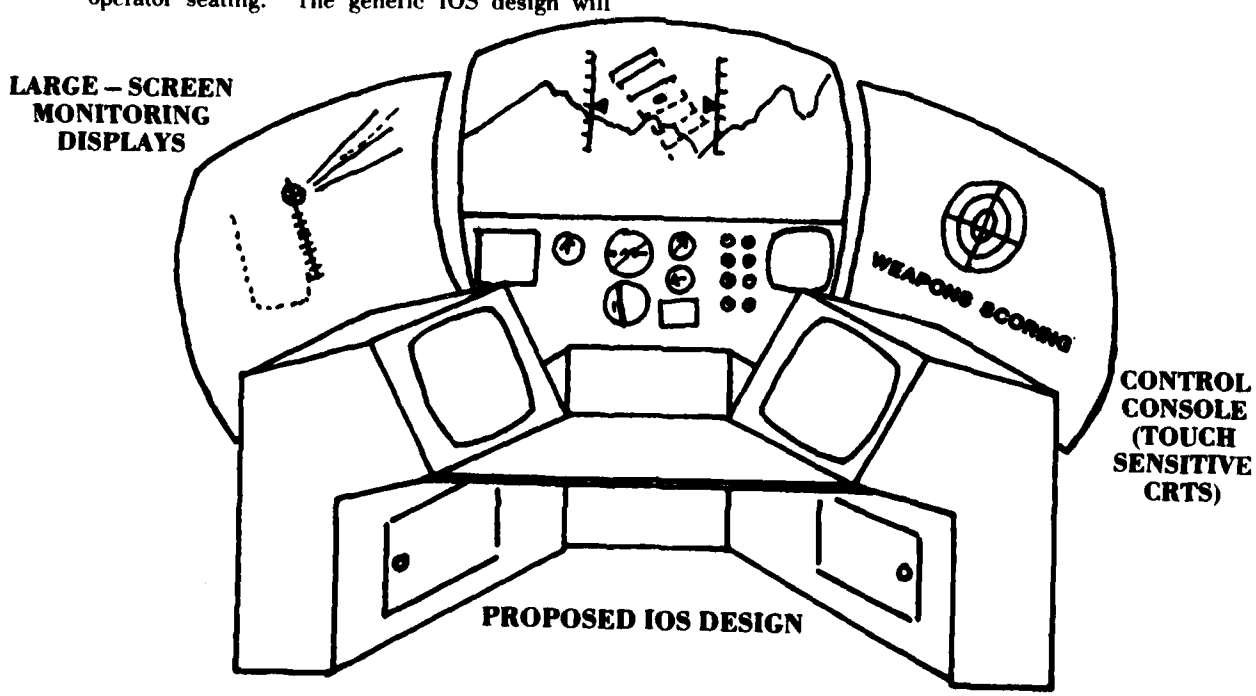
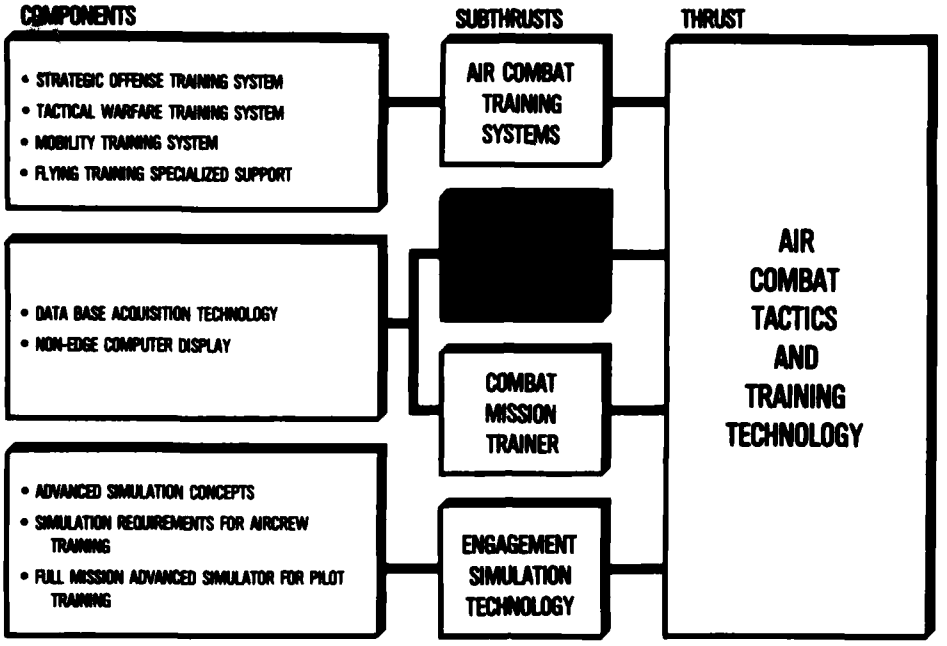
Description: A guide for flight simulator instructor-operator station (IOS) design is being developed. The guide will contain detailed descriptions of a variety of state-of-the-art IOS configurations, relevant human factors specifications for IOS design, and a generic design for future IOS applications. Descriptions of the IOS for the following flight trainers will be provided in the guide: A-10, F-15, F-16, F-4, F-14, F-18, EA-6B, and the Tactical Aircrew Combat Training System. The descriptions will address control and display layout, control operation, and cathode ray tube (CRT) display page format and operation. The human factors design specifications in the guide will include the requirements obtained from a comprehensive review of the relevant literature and will also include design recommendations based on an integration of the requirements in the literature. The areas addressed will include control/display design and layout, workstation configuration, workplace environment, anthropometry, and operator seating. The generic IOS design will provide guidelines for the development of future IOS designs. It will contain recommendations for control/display layouts and operations to maximize the efficiency of the user-equipment interface for a variety of training missions. The IOS design guide will be comprised of two volumes. The first will be directed toward the IOS requirements for fighter/attack flight simulators, and the second will be for tanker/transport/bomber trainers.

A study is being conducted to investigate the efficiency of alternative control devices for IOS interactive CRT displays. The controls are CRT touch panel, light pen, and numeric keyset. These controls will be evaluated in relation to three CRT presented performance tasks involving simulated aircraft weapons loading, aircraft repositioning, and alphanumeric data entry. The CRT displays have been programmed and the controls are operational. Data collection will commence in fiscal year 1983.

Utilization: Both the IOS design guide and IOS controls evaluation will have application to future IOS design. The results of both efforts will provide for the enhancement of the user-equipment interface, and will increase the instructional capability and efficiency of flight simulators. The human factors design recommendations are of immediate interest and value to the Simulator Systems Program Office.





Title: **B-52 Air Refueling Part-Task Trainer Initial Operational Test and Evaluation**

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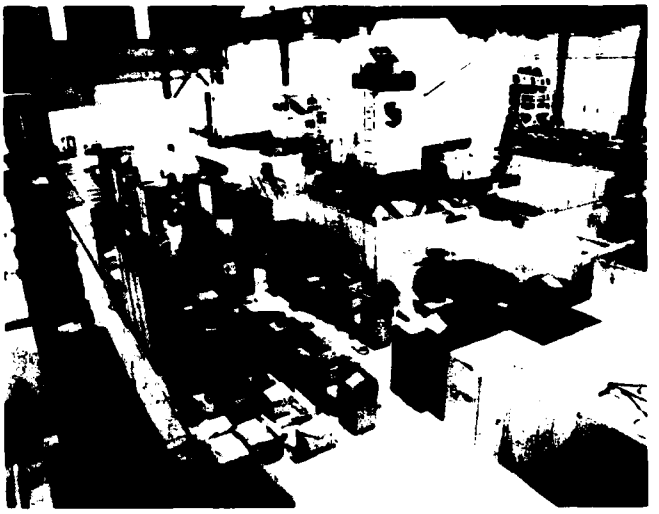
Description: AFHRL supported a Strategic Air Command (SAC) evaluation of the B-52 Air Refueling Part-Task Trainer (ARPTT). This aircrew training device was designed to simulate the cues required to train B-52 pilots in the air refueling task. The system includes a high fidelity replication of a B-52G cockpit mounted on a six-degrees-of-freedom motion platform. Visual cues were presented using a 48° field-of-view display generated by a camera-model system. The primary task for AFHRL was to determine the effectiveness of the ARPTT for training pilots who were being advanced to B-52 aircraft commanders. In addition, the impact of ARPTT platform motion cues on skill acquisition was evaluated. Initially, highly structured curricula produced disappointing results, although students who demonstrated proficiency in the ARPTT tended to reach proficiency in-flight more quickly. The program was changed to allow students to reach proficiency in the ARPTT prior to the flightline phase of training. With this training approach, students demonstrated substantially faster skill acquisition in flight. The effects of motion cueing were mixed. Students who received motion cues tended to be judged proficient earlier in the ARPTT and later in the aircraft than were students who did not receive



B-52 Air Refueling Part-Task Trainer

motion cues, although neither difference was statistically reliable.

Utilization: The ARPTT was part of an Air Force R&D project. Based on the final results of this evaluation, SAC continued to use the ARPTT in Castle AFB training programs. In addition, interim results were used to establish more effective ARPTT training practices.

Benefits: Substantial savings of in-flight resources have been realized through the use of the ARPTT to train not only B-52 pilots, but EC/RC-135 pilots as well. In addition, Military Airlift Command C-141 pilots are currently receiving air refueling training in this device.

Title: **Linear Systems Analysis of B-52 Weapons Delivery Accuracy**

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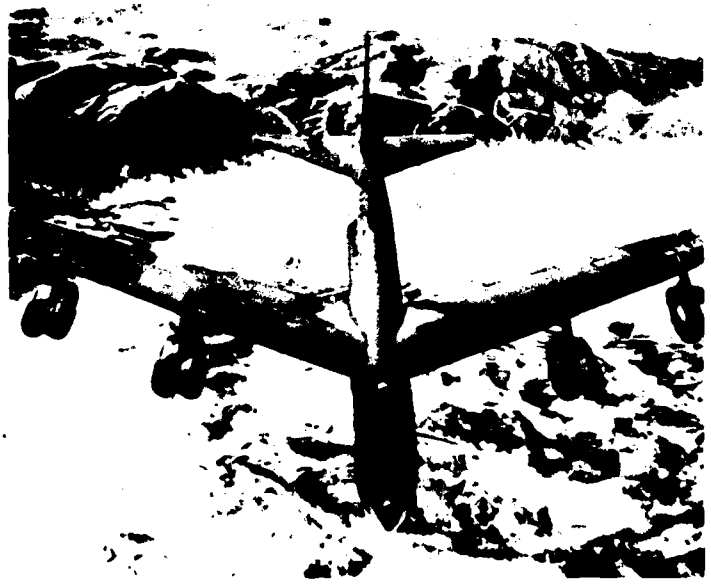
Description: A linear system model was developed to describe B-52 weapons delivery accuracy. In the weapons delivery process, several techniques are operationally interrelated in such a way that differences in accuracy can be attributed to the effects of specific component behaviors. System identification techniques were used to determine mathematical models for these processing behaviors. Synchronous bomb scores, missile scores, and scores from an alternate bombing procedure were included in the original model. Scores reflecting complex weapons delivery procedures were successfully modeled by combining the error distributions of the component tasks. Models of component inaccuracy were then used to suggest changes in procedures by assuming that the component densities reflected the nature of the underlying processes.



B-52 Stratofortress

Utilization: This analytical approach should be generalizable to isolating and studying component processes in other complex behaviors. More recent applications have isolated response, stimulus detection, and attention-switching components for a simple reaction time task. This approach will be used for an analysis of Offensive Avionics System operator accuracy.

Benefits: Substantial improvements were realized in synchronous bomb scores and missile accuracy (short-range attack missile) when procedural changes were instituted. The same results should be achievable throughout the Strategic Air Command by implementation of these procedural changes.

Title: **F-16 Aircraft Back-Up Control Airstart Training Research**

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Description: The proficiency of experienced F-16 pilots in back-up control (BUC) airstart of the F-16/F-100 engine was evaluated to determine whether the airstart system would be modified. The Advanced Simulator for Pilot Training (ASPT) in the F-16 configuration was used to determine the level of pilot airstart proficiency as well as the feasibility of increased training as an alternative to airstart system modifications. The results of the study indicated initially high levels of pilot failure in successfully executing the BUC

airstart. An analysis revealed that pilot errors in initial throttle setting and rate of throttle movement were the major contributing factors. Rapid acquisition of BUC airstart proficiency was found for all pilots during the testing sessions. A comparison between pilots who had received aircraft ground BUC start training and those pilots with no training revealed no significant difference in simulator BUC start performance.

Utilization: The results of the study indicate that modification to the F-16/F-100 BUC airstart system may not be necessary if adequate training in the BUC airstart procedure, specifically throttle management, is provided to F-16 aircrews.

Benefits: Substantial costs incurred by modifications to the F-16/F-100 BUC airstart system may be avoided by implementing a training program in BUC airstart procedures for all operational F-16 aircrews.

Title: **Air Combat Maneuvering Performance Measurement State Space Analysis**

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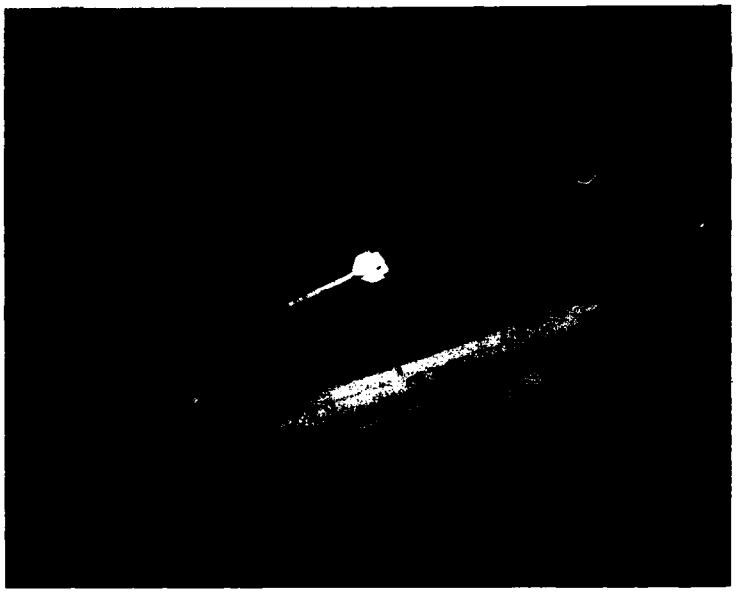
Description: Air combat maneuvering free engagements provide a challenging environment for the measurement of aircrew performance. The rapidly evolving technology in ground-based flight simulation and the data collection and analysis capabilities of the airborne Air Force Combat Maneuvering Instrumentation/Navy Tactical Air Combat Training System (ACMI/TACTS) show promise for providing the kinds of data needed for detailed air combat maneuvering performance measurement. An existing data base of time history data collected during Air Combat Maneuvering (ACM) free engagements on the Simulator for Air-to-Air Combat (SAAC) has been analyzed using a scheme called TACSPACE. This approach divided each engagement into segments according to the relative positions of the proponent and opponent aircraft in terms of aspect angle, line-of-sight angle, and range between aircraft. Several different performance measurement models have been developed from the TACSPACE analyses. These models vary greatly in complexity as different sizes of TACSPACE segments and different analyses within the TACSPACE segments are considered. Large differences existed between the models in their ability to account for performance variance. There is now strong evidence for the efficacy of including measures of control activity in TACSPACE segments corresponding to offensive and defensive positions. Functional specifications based on these analyses provided for several concepts of displaying ACM performance measurement information to SAAC instructor pilots, and it seems feasible to include a similar system on ACMI/TACTS.



F-16 Fighting Falcon

Utilization: The TACSPACE and data analysis concepts developed as part of this effort provide one means of assessing overall maneuvering performance. These will be integrated with the results of other R&D efforts and form the basis of a functional specification for an air combat performance measurement system to be developed for the SAAC and ACMI.

Benefits: The resulting measurement system will provide the Tactical Air Forces with the tools for evaluating the effectiveness of their air combat training programs.

Graphic Depiction of ACM Engagement

Title: **F-16 Stores Management System Training Study**

AFHRL Contact: Bernell J. Edwards
AFHRL/OTU
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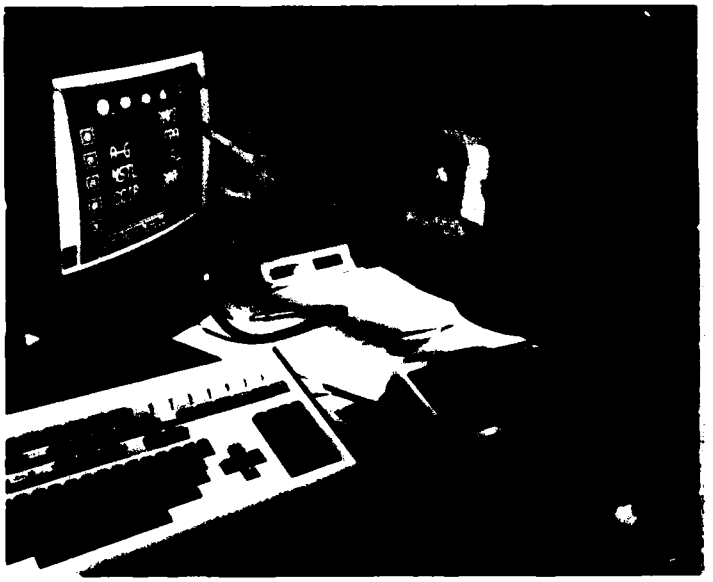
Commercial (602) 988-2611, x 6561
AUTOVON 474-6561

Description: A demonstration was conducted of the effectiveness of desk-top microcomputer technology as applied to the training of F-16 cockpit subsystems procedures at the Operations Training Division of AFHRL. The subjects learned to perform various air-to-surface weapons delivery profiles modifications as part of using the Stores Management System (SMS) of the F-16 aircraft. An experimental group received part-task training via a computer-graphics-supported self-instructional program. A comparison group received the same information using a programmed text. Both groups were tested on their ability to perform the weapons profile modification task on the actual F-16 stores control panel in the ASPT/F-16 simulator cockpit. The experimental group was able to complete the task in significantly less time and with fewer errors than the control group. Study results support the application of inexpensive microcomputers coupled with computer graphics systems as a means of providing self-instructional, interactive training to aircrews for selected procedural tasks.

Utilization: Air Force major commands have become intensely interested in applying low-cost microelectronics systems as a means of reducing training costs. The results of the F-16 SMS study, as a preliminary indication of technology potential, appear promising. Many of the procedural, computational, situational, and other types of cognitive tasks associated with aircrew mission performance may be effectively and inexpensively trained using this approach.

Benefits: The cost avoidance potential of this technology arises from the possibility of training many part-tasks to proficiency earlier in the program, thus facilitating greater efficiency when skills are integrated during training in the simulator and aircraft. This should also reduce the time demands and costs associated with the operation of the more advanced devices.



F-16 Stores Management Trainer

Title: **A-10 Aircraft Combat Scenario Development and Evaluation: Low Altitude Simulation Training**

AFHRL Contact: Byron J. Pierce
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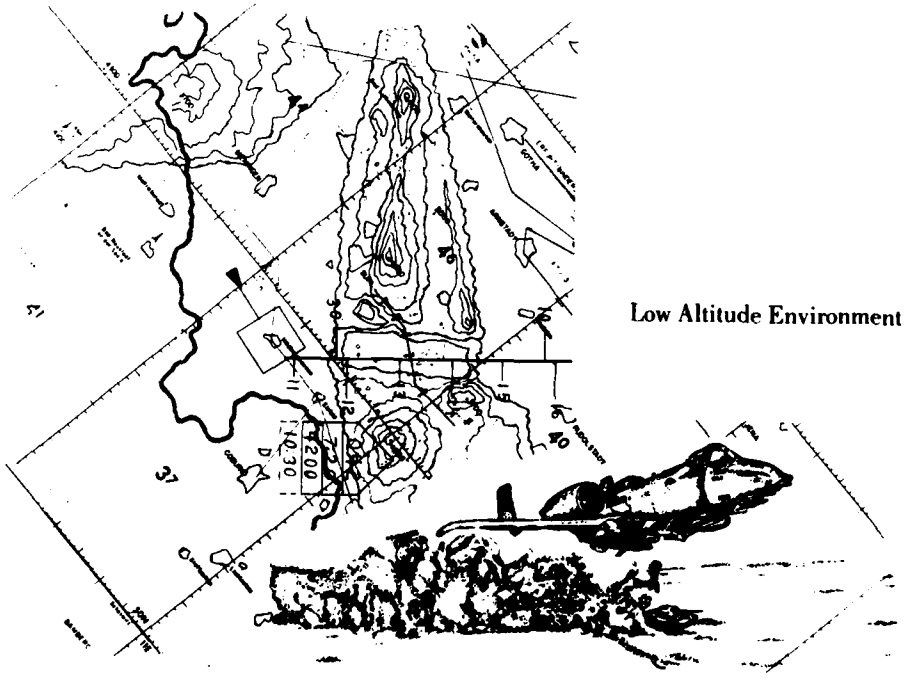
AUTOVON 474-6561

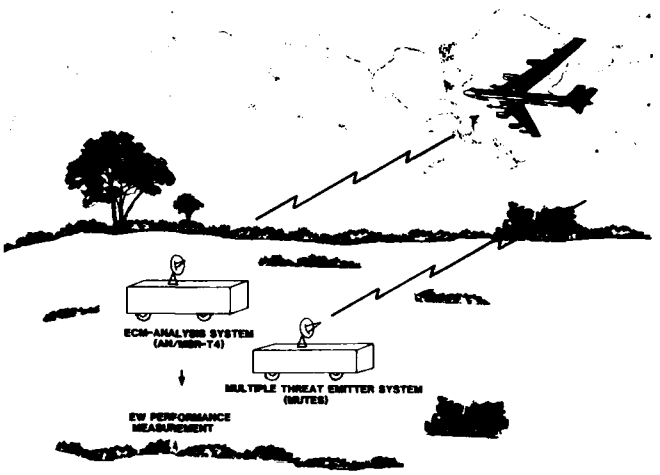
Description: This effort examined the feasibility of providing supplemental basic attack maneuvers and low level navigation training using the Advanced Simulator for Pilot Training (ASPT) in the A-10 aircraft configuration. Specifically, the research assessed the effect such training had on student aircraft performances. Simulator training data showed three of the five tasks trained had significantly improved as a function of ASPT training. Aircraft performance variables derived from instructor pilot evaluations of student performances were not indicative of significant training transfer. The low power values determined from the analyses of aircraft performance variables, the skewed distribution of rating scores, and the conflicting requirements of training versus testing environments culminated in the conclusion that the aircraft performance evaluation procedures used were not sufficiently sensitive for evaluation purposes.

Utilization: The effort helped determine the utility of full-mission simulators in training low altitude tasks. The results were directly applicable to future simulator test and evaluations.

Benefit: The benefits obtained from this study include improved use of training devices and development of simulator transfer-of-training methodologies.



Low Altitude Environment for Simulation



Electronic Warfare Performance Measurement

Title: **Measurement of In-flight Electronic Warfare Officer Performance**

AFHRL Contact: Thomas Killion
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Description: Current methods for scoring electronic countermeasures (ECM) activity during B-52 sorties at Strategic Training Ranges (STRs) do not provide meaningful measures for feedback and training management. A prototype system which performs radio frequency spectrum analyses, the Threat Reaction Analysis and Interpretation System (TRAINS), was evaluated for its capability to provide more effective measures of electronic warfare officer (EWO) performance. This test, GIANT SCORE II, revealed that measures such as reaction time and jamming accuracy were reliably related to situation variables, e.g., complexity of the threat environment, and to operator variables, e.g., EWO experience level. This suggests that such measures could be used profitably with production systems of the TRAINS type to provide feedback to the EWO and to training managers.

Utilization: The measures and data from GIANT SCORE II have already been employed in the design of a portion of the ECM scoring for the 1981 Strategic Air Command (SAC) Bombing/ Navigation Competition (GIANT VOICE). The measures have also been included in the specifications for production models of a TRAINS type system.

Benefits: The measures developed will be used on future ECM systems to provide meaningful feedback concerning daily training activity at STR sites employing this equipment. The data base initiated in GIANT SCORE II and expanded by GIANT VOICE should serve in the development of performance criteria for training.

Title: **Phase I Follow-On Operational Testing and Evaluation of the A-10 Operational Flight Trainer**

AFHRL Contact: Byron J. Pierce
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Commercial (602) 988-2611, x 6561
AUTOVON 474-6561

Description: A follow-on testing and evaluation (FOT&E) was conducted to provide an independent assessment of the ability of the A-10 Operational Flight Trainer (OFT) to train operational piloting tasks. The work was conducted as a joint effort among the Air Force Human Resources Laboratory, the Air Force Test and Evaluation Center, and the Tactical Air Command. The A-10 OFT FOT&E program was prematurely terminated due to modifications made in the A-10 training syllabi necessary for safety of flight. Data collected prior to the termination date showed limited discrimination between groups for aircraft performance variables derived from instructor pilot ratings of student performances. Questionnaires used to poll students and instructor pilots as to the benefits derived from simulator training revealed those tasks for which the OFT training program was most effective.

Utilization: The effort was instrumental in determining the utility of the A-10 OFT in training operational A-10 tasks.

Benefits: Cost-effectiveness of simulator training and proper use of the training device were further benefits of this R&D.

Title: **Generic Threat Recognition Trainer**

AFHRL Contact: Capt Paul D. Gallaher
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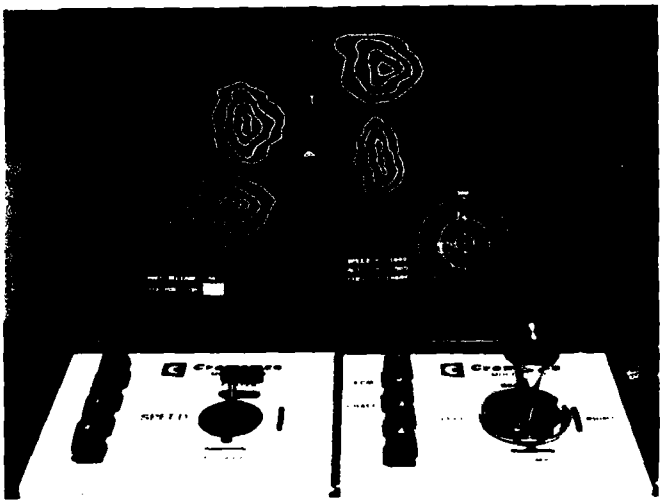
AUTOVON 474-6561

Description: The Generic Threat Recognition Trainer provides the basic gaming elements of air-to-surface electronic combat in a compact desk-top system. The student pilot learns to identify and evade various enemy defenses while attempting to destroy ground targets. Variable terrain features, aircraft flight parameters, radar warning receiver, and electronic countermeasures effects are provided. The trainer is comprised of off-the-shelf commercial devices integrated with a computer. The combination of industry standard hardware and software allows easy implementation of add-on equipment and widely available high-level language processors. The major addition to the basic computer is a very flexible color graphics system. Another addition to the standard system is a joystick and throttle arrangement to allow for analog inputs by the trainee. This arrangement, with its corresponding analog-to-digital interface, allows the pilot to interact with the computer program on a real-time basis. Additional equipment includes voice output and sound simulation. Provision is made for computer-to-computer communication to allow software updating via normal telecon dial-up network. The most outstanding characteristic of the Generic Threat Recognition Trainer is that it is flexible. As requirements change, the system can be easily modified to accept new software and hardware and thus should provide relevant training for many years.

Utilisation: This capability will provide affordable training in threat recognition and advoidance at the operational squadron level for Tactical Air Force personnel. This training will be applicable to numerous aircraft weapons systems and satisfies a training requirement that is largely unfulfilled at the present time. Improved combat readiness and force multiplication through increased weapons effectiveness and survivability in high-threat environments are anticipated.



Threat Recognition Trainer

Title: **Radar Warning Receiver Part-Task Trainers**

AFHRL Contact: Rebecca B. Brooks
AFHRL/OTU
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Commercial (602) 988-2611, x 6561
AUTOVON 474-6561

Description: The objective of the Radar Warning Receiver (RWR) Part-Task Trainer (PTT) research and development (R&D) effort is to evaluate the application of low-cost, advanced microprocessor technology as a means of providing effective part-task training for Tactical Air Command (TAC) aircrews for the RWR. The principal test for the concept will focus on the Electronic Combat Instructor Course (ECIC) presented by the Tactical Air Warfare Center. Although the ECIC is a "graduate" level course, the personnel attending will later instruct students who are novices in RWR and electronic countermeasures (ECM). For this reason, it will be necessary to conduct training R&D on PTTs capable of supporting both initial and continuation training for all tactical missions concerned with RWR system operation.

Utilisation: The software developed in support of this R&D will be compatible with computers TAC has purchased for use in the operational

squadrons. Using the Cromemco computer and AFHRL software, TAC will have extremely low-cost RWR PTTs. A major contractor was attempting to sell RWR PTTs to the Air Force at a cost of $65,000 each; the proposed RWR PTT will cost approximately 10% of this figure. This will mean that RWR PTTs will be readily available for training at the squadron level at an extremely low cost. The pilot's ability to quickly recognize and react to multiple threat warnings in a high-threat environment will result in increased pilot survival and mission success.

Radar Warning Receiver Part-Task Trainer

Title: **B-52/KC-135 Weapon System Trainer Operational Test and Evaluation**

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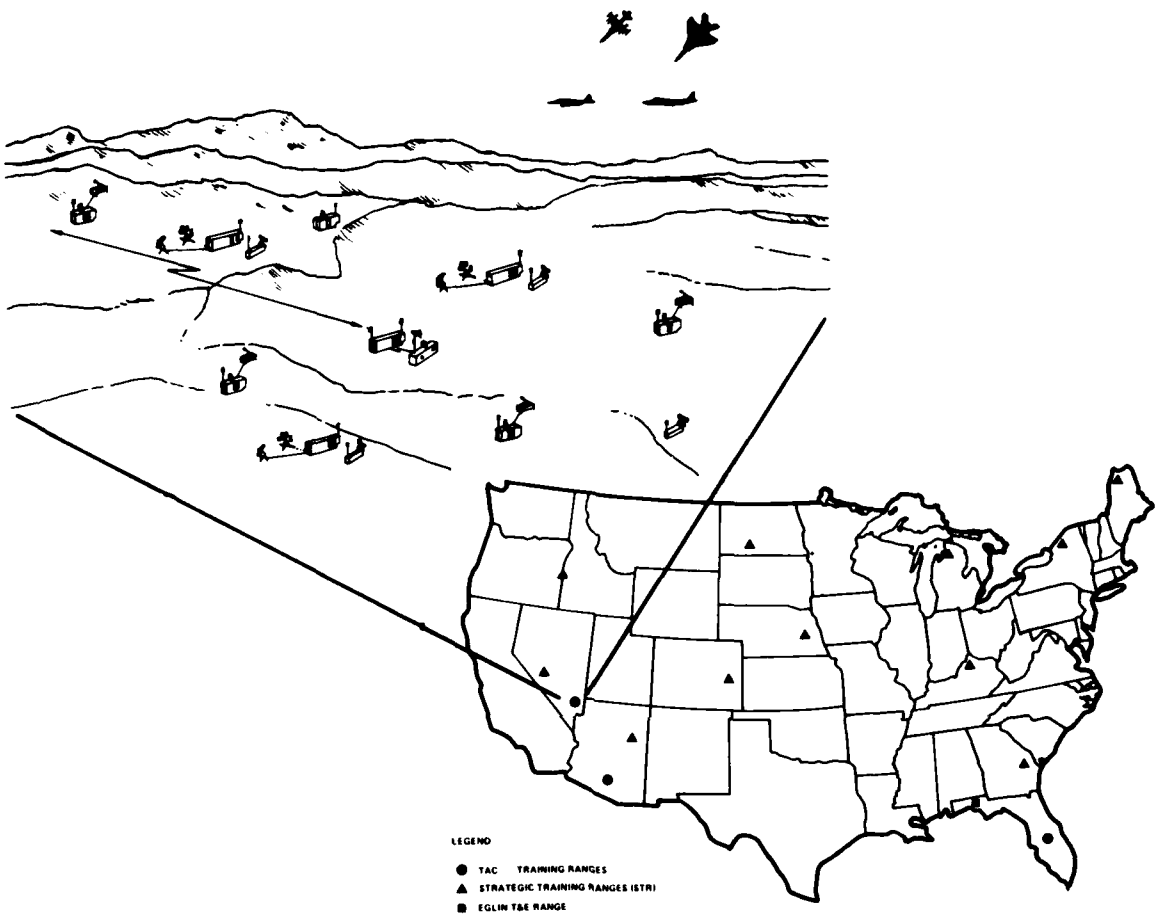
Commercial (602) 988-2611, x 6561
AUTOVON 474-6561

Description: The Strategic Air Command has taken delivery of one KC-135 weapon system trainer (WST) and is in the process of acquiring 10 B-52 WSTs. These are full-crew, full-mission simulators that offer considerable flexibility in terms of how they will be utilized. The KC-135 WST and three of the B-52 WSTs will be deployed to Castle AFB to support initial qualification training. The remaining devices will be delivered to operational B-52 units to support continuation training. AFHRL is providing the expertise needed to support a SAC-managed evaluation of WST training effectiveness. This effort will involve consultation on curriculum integration, the development of a test plan, and the development of B-52 and KC-135 student performance data bases. Initial qualification training effectiveness and continuation training effectiveness are being addressed separately. WST training effectiveness for initial skill acquisition is being assessed by monitoring the impact of WST training on instructor evaluations of student performance, training event accomplishment, and checkride results. Methods of addressing the skill maintenance training potential of the WST will include (a) establishing the impact of WST training on first sortie performance of requalification pilots, (b) assessing the impact of WST training on the acquisition of offensive avionics system skills for mission-ready radar navigators and weapons delivery officers, (c) surveying aircrew estimates of training effectiveness, and (d) evaluating the enhanced training by monitoring changes in aircrew performance.

Utilization: This research is designed to maximize the training potential of the WST and to evaluate its impact on skill maintenance and skill acquisition programs. These simulators are expected to play a major role in the training programs of the Strategic Air Command. To date, a data base of non-WST-trained student performance has been developed. This information is currently being used to modify the existing B-52G, B-52H, and KC-135 curricula and to support the development of WST utilization plans.

B-52/KC-135 Weapons System Trainer



Electronic Combat Range Locations

Title: **Electronic Combat Range Training Effectiveness**

AFHRL Contact: Thomas Killion
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Commercial (602) 988-2611, x 6561
AUTOVON 474-6561

Description: The objectives of this research and development (R&D) are to develop measures of electronic combat (EC) performance and to use these measures to evaluate the effectiveness and utility of EC training concepts. In order to accomplish the objectives, a three-phase R&D effort is proposed. The requirements for the Tactical Air Command (TAC) and Strategic Air Command (SAC) differ somewhat, and those differences are noted in the outline of the three phases.

(1) In Phase I, Review of R&D and of Measurement Capabilities, relevant R&D in the areas of electronic combat, EC training, performance measurement, etc., will be reviewed to determine what has been accomplished in prior work.

(2) In Phase II, Development of Methodology for Measuring Training Effectiveness, measures identified in Phase I will be refined and validated in conjunction with the assessment of the impact of certain training factors.

In support of TAC, the effects of variables such as threat density, feedback, and training frequency can be tested on-site in the Advanced Simulator for Pilot Training (ASPT). Transfer of training within the simulator environment (i.e., from a restricted training environment to a Red Flag type environment) can provide an evaluation of the utility of various factors. At the same time, the effectiveness of certain special function trainers can be identified by examining their impact on performance in the simulator.

Actual in-flight examinations of training effectiveness will be limited in this phase. Primarily, these efforts will focus on development of a measurement capability for in-flight performance. An initial assessment of similarities between simulator and aircraft performance will be conducted, if possible.

In support of SAC, the issue of simulator training effectiveness is being addressed in the B-52 weapon system trainer Follow-On Operational Testing and Evaluation (FOT&E). Measures of electronic warfare officer performance have already been identified and validated. Measurement of performance in the simulator or in-flight in the Strategic Training Range Complex could provide a means for assessing the training effectiveness of particular systems/programs.

(3) In Phase III, Evaluation of an Integrated Program for EC Training for Selected Missions/ Systems, the problems of integrating ground, simulator, and in-flight training to provide an optimal mixture will be addressed. Based on the results of Phase II and inputs from operational sources, an integrated training program will be developed and evaluated for certain missions/ systems.

Utilization: The accomplishment of this training R&D will produce (a) a validated set of measures for evaluating EC performance, (b) a methodology for assessing the training effectiveness/utility of EC training concepts, (c) an evaluation of the training effectiveness/utility of various EC training options, (d) an estimate of the cost-effectiveness of various EC training options, and (e) recommendations for an optimal arrangement of training schedules and systems with regard to type and frequency.

For SAC and TAC, this R&D will define presently unknown requirements for EC training, establish necessary levels of operator proficiency, and provide estimates of EC effectiveness.

Title: **Aerial Refueling Part-Task Trainer (ARPTT) Skills Maintenance Study**

AFHRL Contact: Alfred T. Lee
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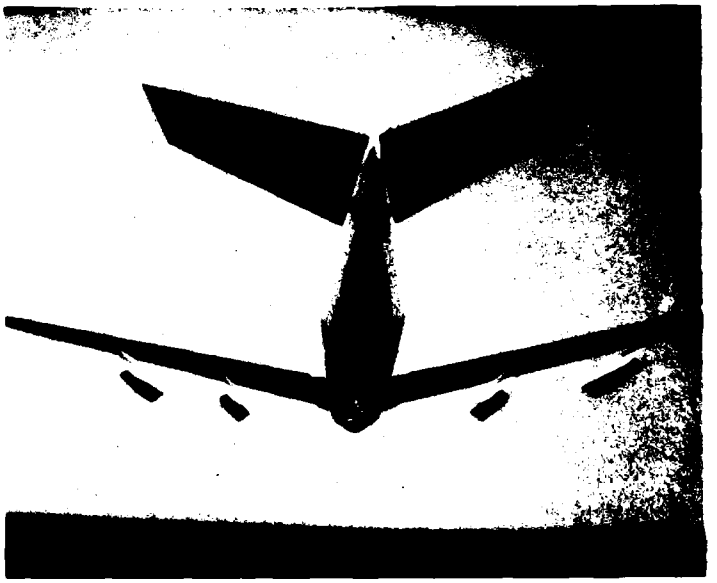
AUTOVON 474-6561

Description: One objective of this research effort is to demonstrate the effectiveness of ground-based aerial refueling (AR) training in the maintenance and improvement of AR skills in crews for the C-5A and C-141B aircraft. Another objective is to provide data to unit commanders in order to facilitate effective allocation of AR training sorties in maintaining aircrew proficiency. Existing ground-based AR training devices will be used to provide training to these aircrews currently receiving less than the number of AR training sorties required for proficiency. A comparison of in-flight AR performance of aircrews receiving ground-based AR to the performance of aircrews not receiving additional



Visual Simulation of Tanker Model

Aerial Refueling Part-Task Trainer will be made, as well as a comparison of both groups to those aircrews meeting complete AR in-flight training requirements.

Utilization: The results of this study will be used to provide the Military Airlift Command with recommendations for the allocation of AR training sorties in the aircraft and on the ground for the maintenance of AR proficiency. This study will provide data on AR training requirements for cost-effective allocation of training resources.

Title: **Integrated Simulator/Airborne Performance Measurement System for the C-5A Aircraft**

AFHRL Contact: Wayne Waag
AFHRL/OTU
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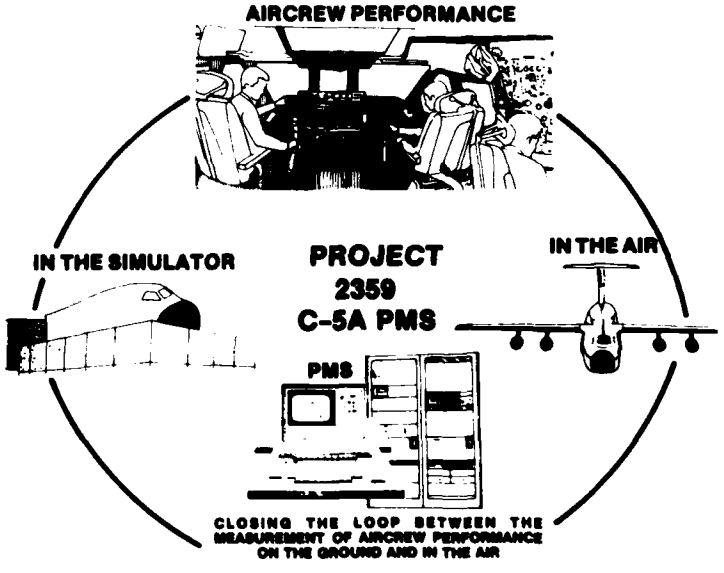
Commercial (602) 988-2611, x 6561
AUTOVON 474-6561

Description: Because of escalating flying costs, there is a critical need to achieve maximum training value from Air Force simulators. The problem resulting from this objective is to determine the relationship of aircrew performance in the simulator to subsequent performance in the actual aircraft. The project is attempting to solve the problem by developing an integrated aircrew measurement system for use on the ground and in the air. The goal is to develop a computer-based system that will generate objective indices of performance in either the simulator or the aircraft. A prototype system is currently being developed using the C-5A aircraft and flight simulator as the test vehicles. The approach has been first to develop a measurement capability for the flight simulator, followed by an extension to the aircraft. The system under development acquires data directly from the flight simulator through several interfaces. It uses its own computational capacity to generate the objective measures of aircrew performance. For the aircraft, objective flight data will be acquired through the C-5's MADAR system. Using a ground-based computer system, the same set of objective performance measures can be calculated. To date, the simulator measurement system has been completed and successfully integrated with one of the C-5A flight simulators at Altus AFB. The next phase of the project is the development of the airborne performance measurement system. Upon completion of the airborne system, the integrated performance measurement system (PMS) (simulator and aircraft) will be evaluated.

Utilization: The C-5 performance measurement system will provide the Military Airlift Command with the means for quantitatively assessing the effectiveness of C-5 aircrew training. As a prototype, the system will aid in the functional specification for future simulators and aircraft. In operational terms, the C-5A Performance Measurement System will enable the objective measurement of many relatively tedious and mundane tasks, such as checklists, procedures, navigational profiles, and maintenance of prescribed flight parameters. As a result, the instructor/examiner will be able to concentrate on higher order skills such as crew coordination and resource management. The PMS can also be used extensively in the simulator training programs, since it has the capability to automatically generate predefined mission scenarios. In this context, the C-5A PMS can provide an important quality control function in that it will become the basis for the more efficient management analysis of training programs. The potential exists for the PMS to provide far better and more uniform quality of training program graduates, far lower "unit" production costs, and increased production rates.



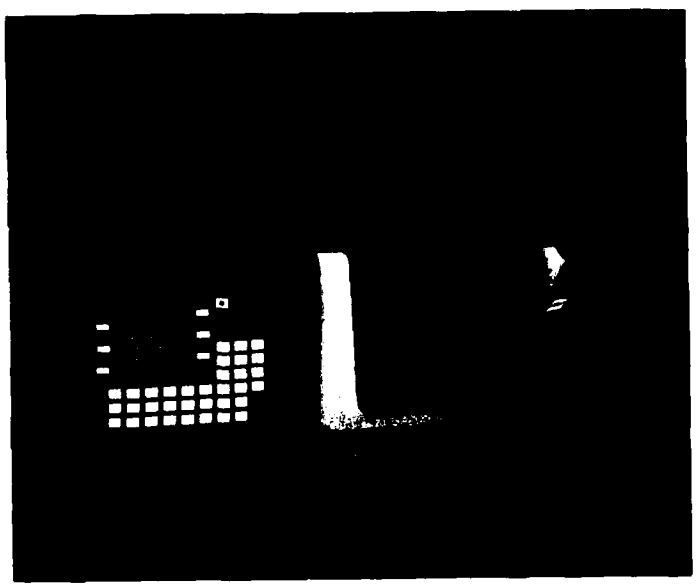
Integrated Measurement System for C-5A

OPERATIONAL UNIT TRAINING SYSTEMS

Title: **Technology for Special Function Training Requirements**

AFHRL Contact: Bernell J. Edwards
AFHRL/OTU
Williams AFB AZ 85224
Commercial (602) 988-2611, x 6561
AUTOVON 474-6561

Description: The technical objective of this R&D effort is to develop and evaluate several "first article" system applications of low-cost instructional technology for the Military Airlift Command (MAC). In this sense, the term "technology" refers to both instructional design methods and the hardware/software aspects of part-task trainer systems. This effort is a cooperative venture in which MAC is providing subject matter experts who have software programming skills. AFHRL is contributing consultative services for the design of courseware, the review and critique of software, and the conduct of field evaluations of the training systems. The purpose of this R&D is to determine the extent to which microcomputer-based special function devices can support MAC part-task training requirements.



MAC Special Function Trainer

Utilization: Assuming successful evaluation of the "first article" systems, it should be possible to develop families of special function trainers to support the majority of the MAC academic phase training requirements. Benefits anticipated are improved efficiency in academic training phases estimated at 25% reduction in training time requirements.

Aircrew Training

Title: **Performance Measurement Requirements for Tactical Aircrew Training**

AFHRL Contact: Byron J. Pierce
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AUTOVON 474-6561

Description: This effort will identify the requirements for a comprehensive aircrew performance measurement system necessary for the efficient conduct, management, and evaluation of Tactical Air Command (TAC) training programs for the F-15, F-16, and A-10 aircraft. The effort will consider all media as they are used in all phases of training. To accomplish these objectives, the effort will (a) define the current TAC needs for measurement information in terms of both the "user" and "intended use" of such information, (b) develop evaluation criteria for

assessing the adequacy of the measurement information, (c) document existing TAC measurement techniques, (d) identify deficiencies in these techniques, (e) identify areas where state-of-the-art technology might be applied, and (f) identify areas where further R&D is necessary.

Utilization: The effort will result in the development of a generic set of performance measurement requirements for tactical aircrews and improved techniques for the evaluation of aircrew proficiency and the effective management of flying training programs.

Title: **C-130E Weapon System Trainer Operational Test and Evaluation**

AFHRL Contact: Robert T. Nullmeyer
AFHRL/OT
Williams AFB AZ 85224
Commercial (602) 988-2611, x 6561
AUTOVON 474-6561

Description: The Military Airlift Command (MAC) is procuring 10 C-130 instrument flight simulators (IFSs). These simulators provide high fidelity replications of all C-130 crew stations, except for the load master. A wide field-of-view, full day/night, color, six-window, five-channel computer image generation visual system was added to the pilot production IFS to form the C-130E weapon system trainer (WST). AFHRL is supporting a MAC-managed follow-on operational test and evaluation (FOT&E) of this WST. This FOT&E is primarily concerned with evaluating the impact of the visual system on IFS training effectiveness. This effort will compare IFS and WST effectiveness for initial qualification training, mission qualification training, and continuation training. A second, closely-related issue is the ability of the WST to train tactics and provide combat training. Initial acquisition of tactical skills will be evaluated using mission qualification students. Enhanced training (e.g., emergency procedures and preparation for Red Flag/Maple Flag exercises) will be evaluated using mission-ready crews. The impact of WST training on skill reacquisition will be evaluated using requalification students. The primary roles of AFHRL in this FOT&E are to develop a test plan in conjunction with MAC and to analyze and report the results of these evaluations.

Utilization: The results of this FOT&E will be used to support two major decisions. The first is a procurement decision regarding visual systems for the remaining IFSs. Estimates of how the visual system impacts training effectiveness will enable an in-depth comparison of benefits and costs. The second, not entirely independent, decision is how to use the devices most effectively. Utilization plans will likely drive visual system requirements for the remaining devices. The visual system is expected to greatly enhance the training effectiveness of the instrument flight simulators. This should allow substantial reallocation of in-flight training resources and result in enhanced training for C-130E aircrews and more efficient aircrew training programs.

Title: **Air Combat Measurement System for the Simulator for Air-to-Air Combat and the Air Combat Maneuvering Instrumentation**

AFHRL Contact: William Nelson
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Luke AFB AZ 85309
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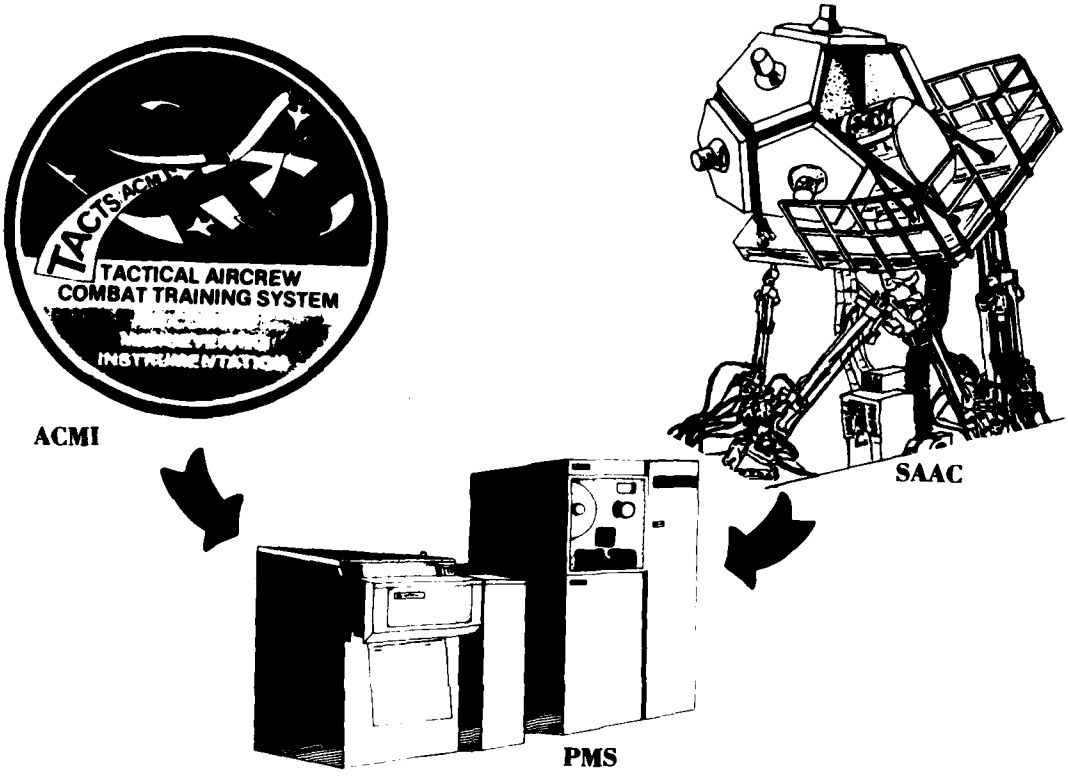
AUTOVON 835-7058

Description: The specific problem addressed in this R&D is the lack of a performance measurement system for the Simulator for Air-to-Air Combat (SAAC) and the Air Combat Maneuvering Instrumentation (ACMI). The SAAC is the only Air Force simulator used for close air-to-air combat training. The ACMI, on the other hand, enables the monitoring of airborne engagements. Unfortunately, neither of these devices has an Air Combat Maneuvering measurement capability. There are two objectives of this effort: (a) the refinement of the all-aspect maneuvering index model originally developed for the Navy and (b) the development of a design specification for an integrated measurement system for the SAAC and the ACMI. A prototype development is planned as a follow-on to this effort.

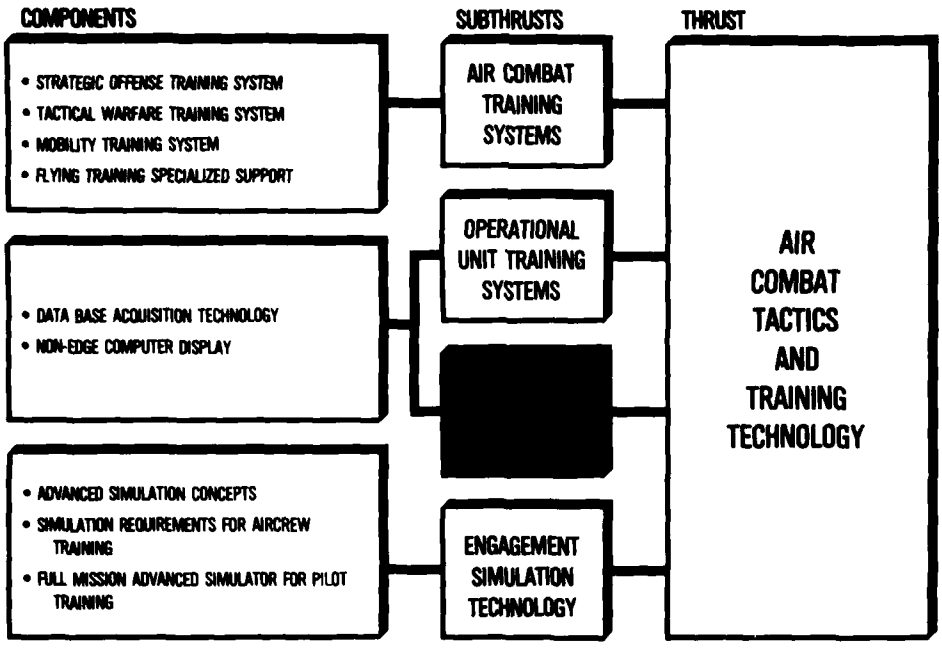
Utilization: The ACM performance measurement system will provide the Tactical Air Force with the means for quantitatively assessing mission readiness and evaluating the effectiveness of the air combat training programs. It will also provide mission feedback, thus improving the

OPERATIONAL UNIT TRAINING SYSTEMS



INTEGRATED PERFORMANCE MEASUREMENT
SACC/ACMI

effectiveness of available training resources. The system will provide AFHRL with the needed measurement capability for pursuit of air combat training R&D. At present, the lack of an objective means of assessing ACM combat performance has prevented certain critical issues from being properly addressed. The development and validation of such objective measures would provide answers to questions that could potentially impact the combat readiness of our forces. First, it would enable the precise definition of ACM training event requirements and therefore permit flying hour requirements to be based on aircrew proficiency needs rather than best guesses. Second, it would provide the tools necessary for establishing simulator utilization requirements for initial skill acquisition as well as for continuation training.



COMBAT MISSION TRAINER — ON-GOING R&D

Title: **Combat Mission Trainer**

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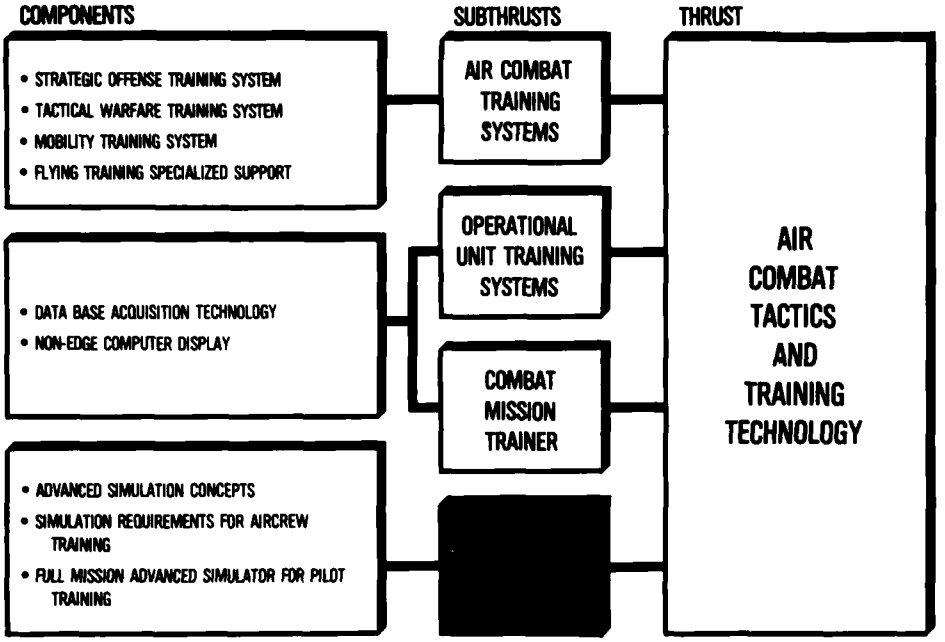
x 6561
AUTOVON 474-6561

Description: A Combat Mission Trainer (CMT) is being developed to provide training for combat essential tasks at minimum cost. Initial emphasis has been placed on the development of a Fiber Optic Helmet-Mounted Display (FOHMD) for use in the CMT. A breadboard display has been built using a mechanical helmet sensor. The image generator for breadboard FOHMD demonstration will be provided by two F-111 digital image generators (DIGs) presently on loan to AFHRL from Tactical Air Command. During fiscal years 1983 and 1984, development will include basic research into the acceptability of a helmet-mounted system. A prototype FOHMD will be built to incorporate an optical helmet sensor with improved dynamic accuracy and an improvement in helmet optics. The prototype FOHMD development will provide major cost and size reductions necessary to support the program objectives. An instructor operator station suitable for a helmet-mounted visual display trainer will also be developed. The complete fulfillment of the program objectives will incorporate new visual technologies developed by other projects, e.g., Advanced Visual Technology System, Advanced Visual/Sensor Simulation (AVSS) non-edge computer image generation; eye tracking systems; and emerging videodisc technology. This system offers a major cost reduction over a conventional mosaic cathode ray tube or dome-based simulator. Visual simulation performance goals relative to ASPT or to present state-of-the-art systems include 1000% improvement in final display brightness, 300% improvement in resolution, and 300% improvement in displayed edge equivalency.

Utilization: The affordability and transportability of a CMT will provide a previously unavailable opportunity to train critical combat mission skills at the unit level. Research has shown a rapid loss of the finely tuned skills needed

for full combat effectiveness. By offering an opportunity for frequent simulated practice of realistic combat tasks, individual combat skills can be maintained at peak proficiency. This will serve as a significant force multiplier through increased enemy kills and enhanced survivability.

Combat Mission Trainer



ENGAGEMENT SIMULATION TECHNOLOGY

TECHNICAL ACHIEVEMENTS

Title: **Combat Environment Simulation Development**

AFHRL Contact: Capt Jack Kalata
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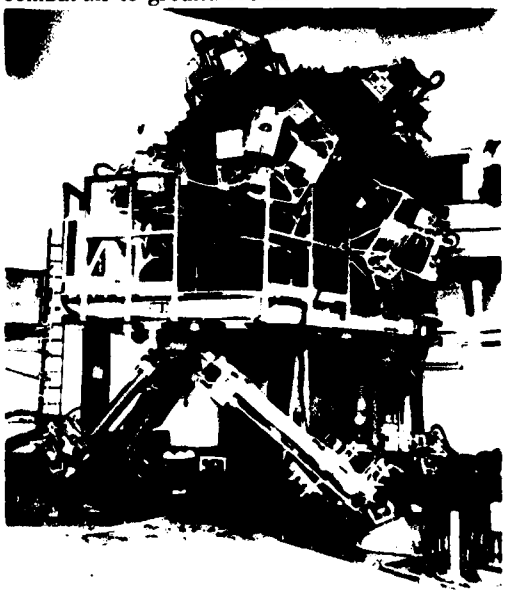
Commercial (602) 988-2611, x 6561
AUTOVON 474-6561

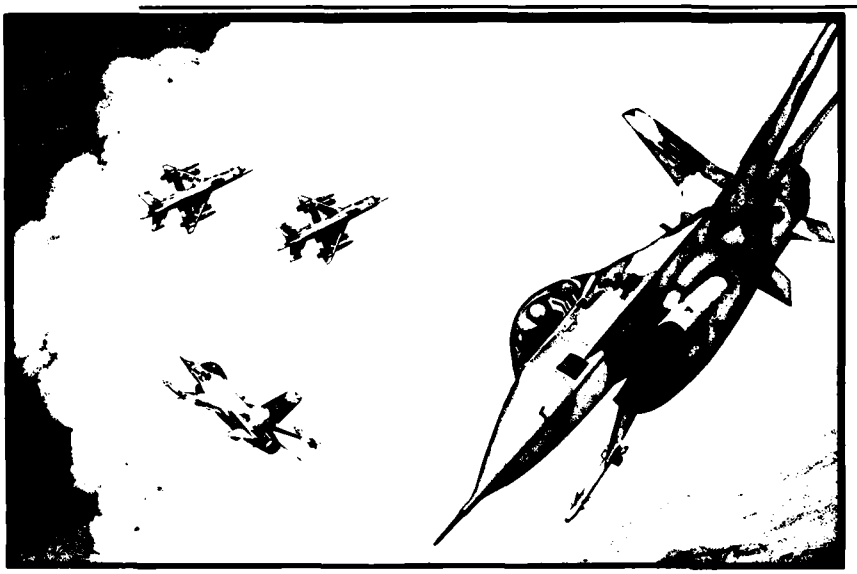
Description: The conversion of the Advanced Simulator for Pilot Training (ASPT) to an A-10 and F-16 aircraft configuration created an opportunity for engineering development of simulated combat environments. Various hostile environments have been developed and improved to the point where realistic terrain models, interactive surface-to-air missiles, anti-aircraft artillery, and defensive measures are all incorporated. Current environments include the Nellis AFB Tonopah range and the Fulda Gap region of Germany. Continuing engineering development includes improved threat models and sensor displays.

Utilisation: The F-16 cockpit will continue to be used for Tactical Air Command (TAC) weapons delivery training. Both the A-10 and F-16 simulators are used for research. AFHRL research is currently being conducted in the low altitude flight regime, which includes transfer-of-training studies for the A-10 and F-16 aircraft. Effectiveness studies have been proposed for new weapon systems that include nuclear effects, and directed energy weapons.

Benefits: The F-16 simulator provided TAC with training that was otherwise unavailable and is an invaluable research device for high threat combat air-to-ground scenarios.



F-16 Simulator



Air-to-Air Combat Depiction

Benefits: An air-to-air capability will enhance ASPT threat simulation. Airborne enemy aircraft will increase ASPT task loading and force the pilot to be situationally aware of the total environment.

Title: **F-16 Aircraft Air-to-Air Capability**

AFHRL Contact: Capt Jack Kalata
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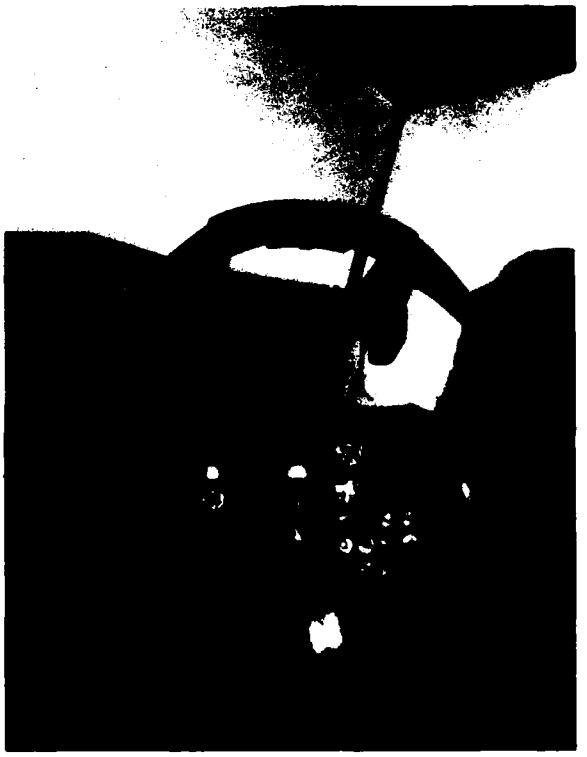
AUTOVON 474-6561

Description: An air-to-air capability is being developed for the F-16 Advanced Simulator for Pilot Training (ASPT). This capability will include a radar, head-up display, and stores management subsystem integrated to provide the pilot with four different air-to-air combat modes of operation. Air engagements will initially be one-versus-one. The adversary aircraft can either be flown by a joy stick or controlled by a programmable computer generated image. ASPT pilots will receive real-time scoring of the 20 mm gun and the AIM9J or AIM9L missile.

Utilization: This capability, added to ASPT, will provide a device for research in the air-to-air realm of combat operations. This will also enhance the present ASPT air-to-ground capability and provide a full-mission simulator operational throughout the entire tactical combat environment.



ASPT A-10 Cockpit

Title: **A-10 Aircraft Simulation**

AFHRL Contact: Capt Jack Kalata
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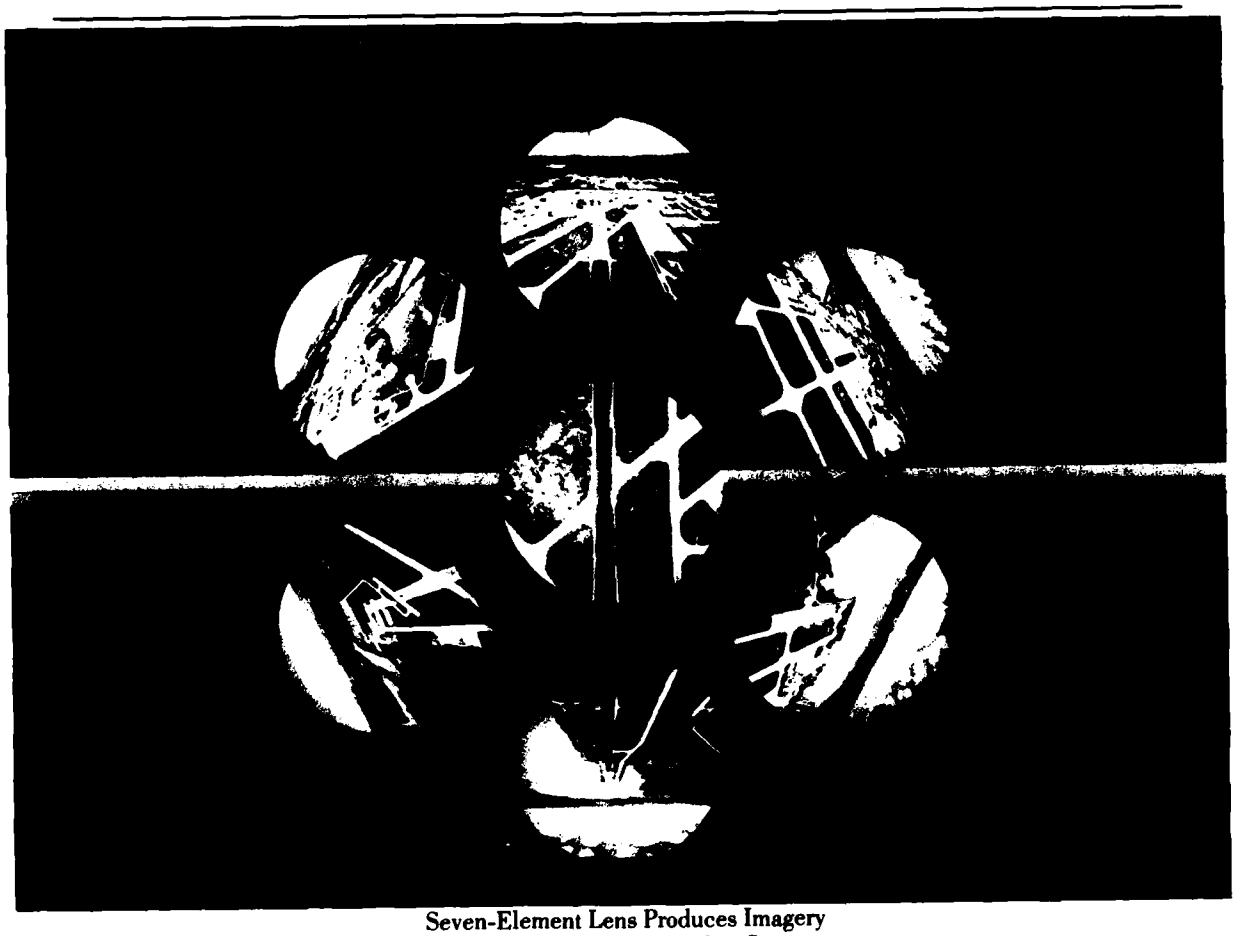
x 6561
AUTOVON 474-6561

Description: One cockpit of the Advanced Simulator for Pilot Training (ASPT) has been developed into a realistic A-10 aircraft configuration. A seven-channel visual system provides a pilot with a full field-of-view display. The ASPT A-10 hardware and software were developed using a modular design that will allow new aircraft capabilities to be quickly incorporated into the simulator. The current system provides for the air-to-ground delivery and scoring of bombs and the 30 mm cannon. Also, in addition to the the normal flight control system, the manual reversion flight control system is simulated.

Utilization: The A-10 cockpit was used by the Tactical Air Command (TAC) for all A-10 training until their A-10 simulators were delivered. An A-10 combat transfer-of-training study was conducted using TAC pilots scheduled to go to Red Flag. A helmet-mounted display study is being developed to determine the benefits of stereoscopic vision.

Benefits: The A-10 simulation provided training, for TAC, that was otherwise unavailable, as well as an invaluable research device for high threat combat air-to-ground scenarios.

A-10 Thunderbolt II



Seven-Element Lens Produces Imagery
for Vought CAPTV Videodisc System

Title: **Video Disc Technology Application to Real Mission Visual Simulation Scenarios**

AFHRL Contact: Dan McGuire
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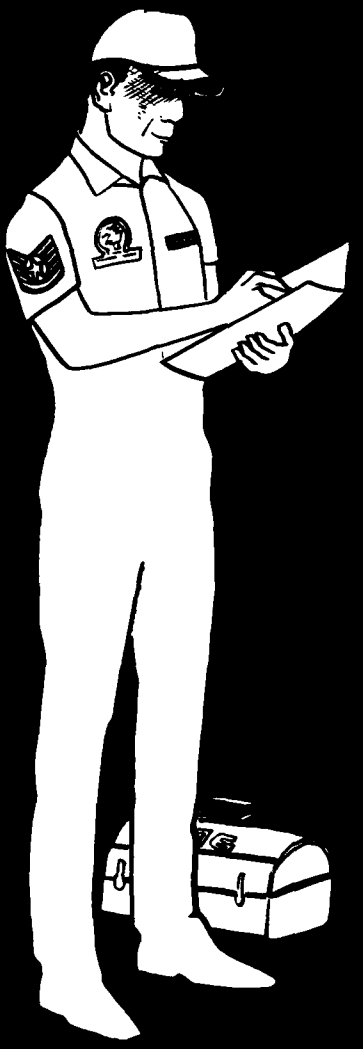
x 6561
AUTOVON 474-6561

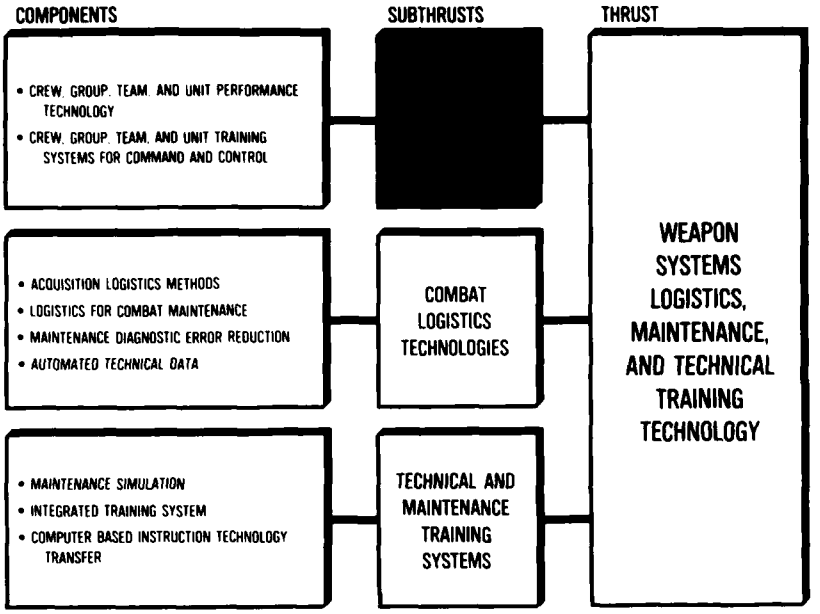
Description: A study effort has been initiated to investigate the extension of the Vought Corporation Computer Animated Photographic Terrain View (CAPTV) technology to combat fighter training requirements. The study involves new developments in three areas of the full color, wide field-of-view visual system now under construction for the Navy A-7 Weapon System Trainer project. The first area of study is the low altitude image transformation algorithms to reduce data base requirements. The second study area is image data base storage architecture and alternate sources such as non-real-time computer-generated imagery. The third study area is the addition of moving models, targets, and other computer-generated imagery effects.

Utilization: The successful development and integration of this technology could represent a major breakthrough in visual simulation. The non-processing intensive nature of the system would allow a major advance in terms of visual scene detail, texture, and realism compared to the computation bound approach in total computer-generated imagery systems. The terrain textural fidelity capability inherent in this approach may finally provide realistic simulation of real-world tactical environments. Especially notable is the potential for simulation of realistic missions requiring low-level navigation for threat avoidances.

WEAPONS SYSTEMS LOGISTICS MAINTENANCE AND TECHNICAL TRAINING



WEAPON SYSTEMS LOGISTICS, MAINTENANCE AND TECHNICAL TRAINING THRUST



CREW, GROUP, TEAM, AND UNIT PERFORMANCE AND TRAINING SYSTEMS

TECHNICAL ACHIEVEMENTS

Title: **Tactical Air Warfare Center Support**

AFHRL Contact: Judith C. Krebs
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AUTOVON 785-2606

Description: Two analytic efforts were conducted in support of the Air Force Tactical Air Warfare Center (USAF/TAWC) by the Blue Flag Task Analysis and Battle Staff Course (BSC) Review.

The Blue Flag exercise provides realistic training for tactical command and control personnel. In support of Blue Flag, a detailed task analysis was conducted on five Blue Flag Senior Control Cells: Red Cell, Battle Damage Assessment Cell, Wing Operations Cell, Tactical Reconnaisance Cell, and Air Defense Cell. The completed analysis provides a narrative description supporting the task analysis, functional flow diagrams, a list of acronyms, and recommendations for providing automated aids for training and evaluation.

The BSC Review, conducted at the request of the Air Ground Operations School, provided a nonparticipant, unbiased review of the BSC architecture and teaching methodology. The completed report provides practical recommendations that can be implemented within the constraints of the school's existing operations, as well as long-term and advanced technological recommendations.

Utilization: The results of the Blue Flag analysis will support efforts to provide automated assistance to Blue Flag Senior controllers during the conduct of Blue Flag exercises. This analysis will also serve as a basic training guide for

upcoming Blue Flag support personnel. The results of the BSC Review provided short-term recommendations which were used to modify the existing BSC. The long-term recommendations and advanced technology recommendations will be used to plan and project future changes and requirements.

Benefits: Implementation of the recommendations from these two efforts is expected to increase the effectiveness and efficiency of command and control personnel training at USAF/TAWC.

Tactical Command and Control: Concept and Process

Title: **Three-Dimensional Computer Graphics Display for Training Weapons Directors**

AFHRL Contact: Lawrence S. Finegold
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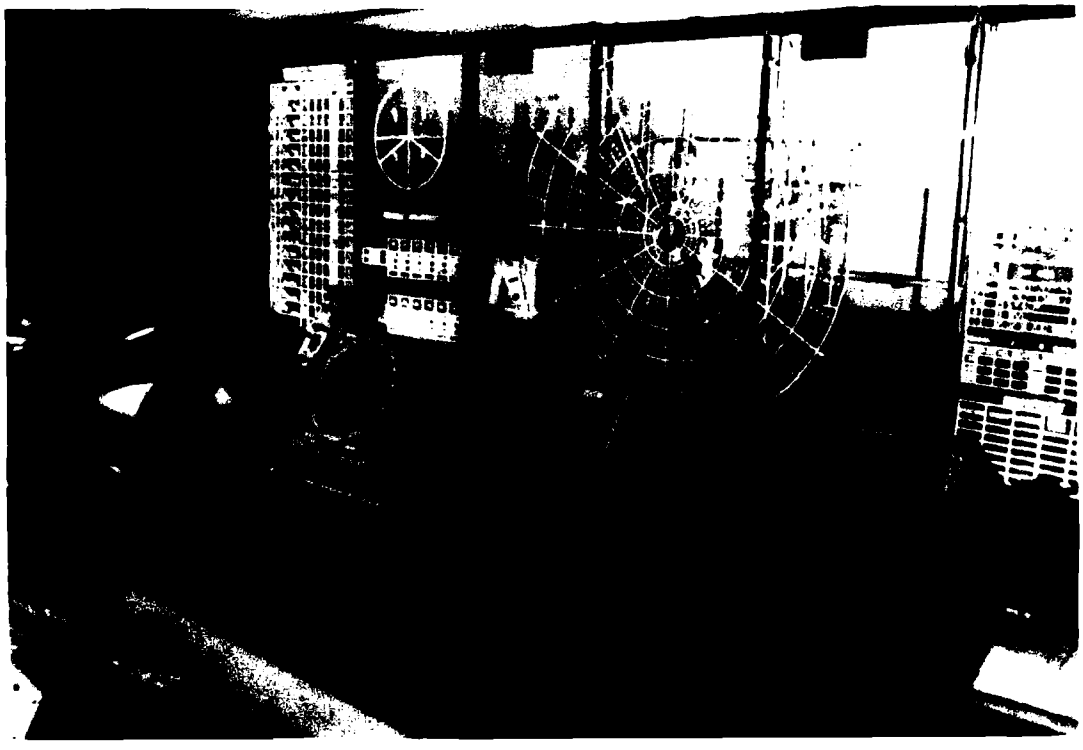
Description: This effort investigated the feasibility of supplementing the training provided to Weapons Directors with a three-dimensional computer graphics simulation of aircraft flying in a confined airspace. In addition to the real-time, animated display of two friendly interceptor aircraft and one target aircraft, additional software was developed to display geometry involved in aircraft interception. In order to test the feasibility of using relatively low-cost computer technology, the whole display system was developed on a microcomputer using less than 7.5 megabytes of computer memory. In order to transition this display system to the training environment, complete mission flight profiles were developed using two types of intercept tactics. Two cassette videotapes have been produced for direct use in Weapons Director training programs.

Utilization: The cassette videotapes using the three-dimensional computer graphics display capabilities were delivered to the Air Force Interceptor Weapons School at Tyndall AFB to be used in the Automated Positionally Qualified training course.

Benefits: It is expected that viewing these videotapes will help students to better understand the geometry involved in performing aircraft intercepts while using the two-dimensional operational equipment. This should improve the performance of students during training as well as their later performance on the job.



Air Defense Team in Operation

Title: **Assessing Command and Control Team Performance**

AFHRL Contact: Lawrence S. Finegold
AFHRL/LRLG
Wright-Patterson AFB OH 45433
Commercial (513) 255-5910
AUTOVON 785-5910

Description: This project is an initial effort to address some of the theoretical and methodological issues involved in assessing the performance of command and control teams. These issues include (a) combining measures of performance on individual and team tasks, (b) developing performance criteria for team tasks, (c) using performance assessment data to provide diagnostic and prescriptive feedback to the team, and (d) identifying critical individual and team tasks and the factors that affect their performance.

Two specific subteams within the 9th Air Force Tactical Air Control System have been chosen as the focus of this study. In addition to an identification of the critical individual and team tasks and an evaluation of the techniques currently used to assess the performance of these two operational groups, this project will result in the development of a prototype methodology for assessing their performance.

Utilization: The results of this project will provide an input to later research and development projects in this area. The end products of this line of research will be improved methods for team performance measurement/evaluation that can be used by exercise planning personnel within the Tactical Air Command, with special emphasis on the Wing System Training Exercise capability within the 9th Air Force.

Title: **Tactical Battle Management Research Capability**

AFHRL Contact: George A. Frekany
AFHRL/LRLG
Wright-Patterson AFB OH 45433
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AUTOVON 785-5910

Description: The near-term objective of this effort is to provide an in-house research capability to study the decision-making behavior of tactical battle-staff personnel assigned to command and control systems. The intent of these studies is to generate the type of basic knowledge that can lead to the development of training programs for decision makers and possibly to design guidance for decision-aiding computer hardware/software. The present configuration of the system supports five test/experimental stations. Each station consists of a graphics monitor with associated joystick and an alphanumeric terminal with associated keyboard. The test/experimental stations are "driven" by a software package: the Tactical Battle Management Software. This interactive, user-oriented software has the capability for on-line recording of all user-system transactions for post-experimental data analysis. The system emulates the functions performed in the Fighter Plans Branch of a generic tactical air control center. The task of the subjects will be to schedule offensive counter air missions against selected enemy targets. In order that subjects may accomplish this task, they will be presented with tactical maps via the graphics monitor and detailed textual information about both the target environment and available friendly assets via the alphanumeric terminal.

Utilization: Initial studies using this system will examine the decision-making behaviors of individual, command-level personnel from operational command and control systems. These data, in combination with data from other related efforts, will serve as a baseline for the examination of team decision-making behaviors exhibited by tactical battle-staff personnel. The capability to allow examination of group decision-making behaviors has already been built into the system.

Experimental Station for Tactical Battle Management Simulation

Title: **Human Factors Support of the United States Air Forces in Europe Tactical Fusion Center**

AFHRL Contact: Bertram W. Cream
AFHRL/LRLG
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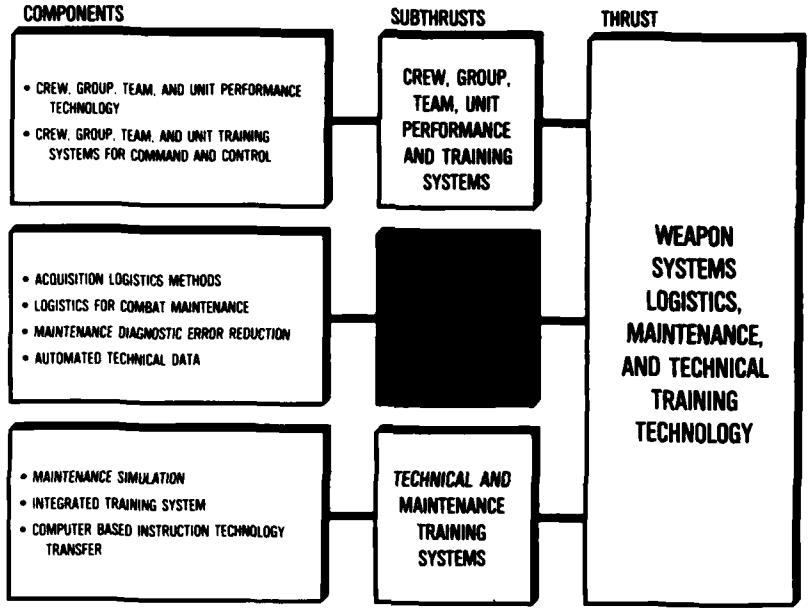
Commercial (513) 255-5910
AUTOVON 785-5910

Description: At the request of the Directorate of Intelligence Systems of the United States Air Forces in Europe (USAFE/INY), the Air Force Human Resources Laboratory (AFHRL) and the Air Force Aerospace Medical Research Laboratory (AFAMRL) sent two representatives to the Federal Republic of Germany for the purpose of conducting a preliminary assessment of human factors/human performance issues relevant to the planned upgrade of the USAFE Tactical Fusion Center (TFC). As part of a large program that has been on-going for a number of years, a series of incremental improvements have been accomplished and are planned for the TFC. These have been primarily in the area of automated data processing, information systems, and display technology. As part of this evolutionary growth, the next major upgrades will substantially change the equipment composition, equipment location, and procedures in the current TFC. USAFE/INY expressed concern regarding these changes in terms of impact on operator performance, location, training, information flow, procedural integrity, and combat effectiveness. USAFE/INY requested AFHRL/AFAMRL to conduct a preliminary assessment of the impact of these changes and to make recommendations regarding actions that might be taken to ensure maximum benefit from these TFC upgrades. Prior to the visit to the TFC, a visit was made to the Electronic Systems Division (ESD) of the Air Force Systems Command to discuss their plans relevant to the TFC upgrades. As a result of the trip to ESD and USAFE, a report was sent to USAFE/INY detailing the observations, conclusions, and recommendations of the AFHRL/AFAMRL team regarding TFC upgrade plans. Follow-on work to implement these recommendations is now undergoing review by USAFE/INY.

Utilization: This effort will provide recommendations that can be used to implement short-term improvements and support long-term planning for the USAFE TFC.

Experimental Tactical Fusion Center



COMBAT LOGISTICS TECHNOLOGIES — TECHNICAL ACHIEVEMENTS

Title: **Acquisition of Supportable Systems Evaluation Technology**

AFHRL Contact: Rosemarie J. Preidis
AFHRL/LRLA
Wright-Patterson AFB OH 45433
Commercial (513) 255-3771
AUTOVON 785-3771

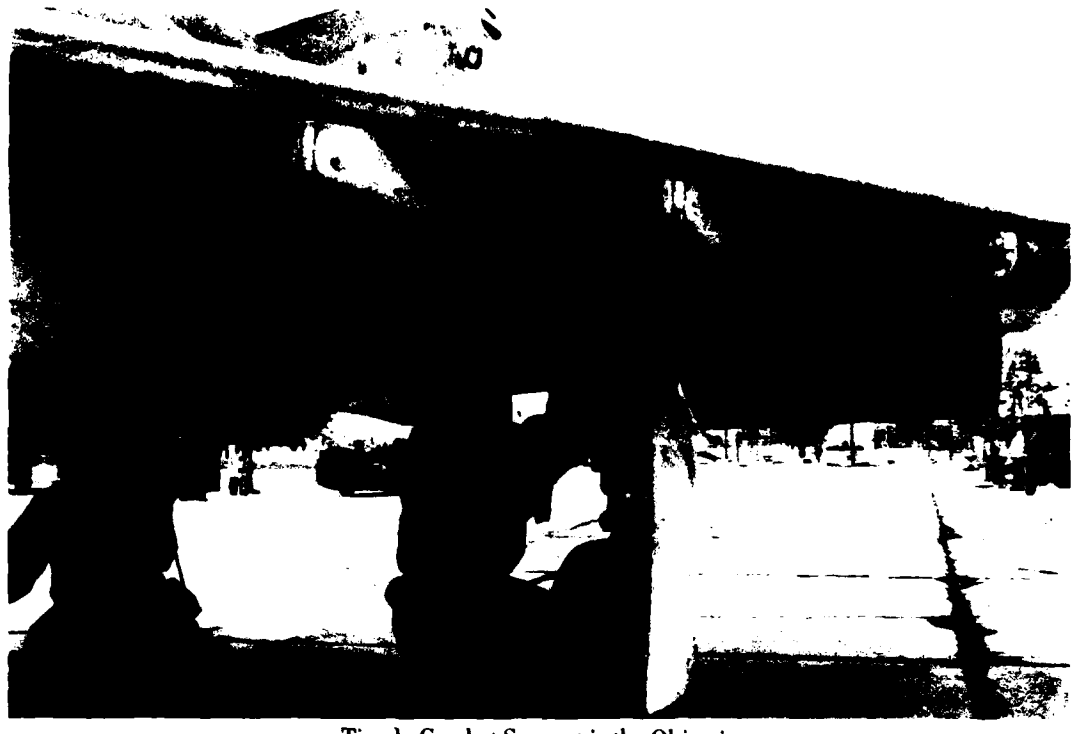
Description: This was the final phase of a four-phase effort to develop and test a technology to support the integration of manpower, personnel, training and related logistics considerations with the weapon system development process. Acquisition of Supportable Systems Evaluation Technology (ASSET) is a systematic, proceduralized methodology that can be used (a) to provide assessments of cost, human resources, and related logistics resources required for the operation and support of weapon systems, (b) to ensure that supportability and human resources impacts are explicitly considered in the design of a weapon system and are traceable, and (c) to coordinate the development of training programs and technical manuals to ensure complete and cost-effective maintenance performance in the field. ASSET consists of eight analysis procedures, six computer models, and a consolidated data base which supports utilization of the procedures and models. The analytical procedures are the central feature of ASSET; the computer models are used to support application of the procedures. The consolidated data base serves as a single repository of all data required for ASSET application. The objectives of Phase IV were first, to evaluate the integrated technology and revise it as necessary so that it would be suitable for application, and second, to develop materials suitable for transitioning the technology from the laboratory to the user. The technology evaluation included a thorough review of all previously developed documentation, exercise of all computer programs and models, and small scale applications of portions of the technology. Results indicated that the methodology is basically sound and usable. To facilitate transition of the technology, the following materials were developed: (a) a managerial overview of ASSET, (b) a users' guide to support application of the ASSET technology, and (c) a users' guide

supplement containing source listings, logic flow diagrams, sample input data sets, and sample output reports for each computer model in ASSET.

Utilization: The ASSET technology is intended to be applied during all phases of the development of weapon systems and other major items of hardware. ASSET has been designed so that the components of the technology can be applied separately or the complete package can be utilized, thus allowing the system to be tailored to the user's specific needs. The ASSET computer models are resident in the Aeronautical Systems Division computer at Wright-Patterson AFB, thus facilitating their use. Also, many of the computer models are interactive and, therefore, are able to respond to the rapid turnaround time often required during weapon system development. The methodology is sufficient for use on a stand-alone basis but can be extended to interface with other tools and analysis approaches, e.g., logistic support analysis and the LCOM maintenance manpower model.

Benefits: Application of ASSET to developing weapon systems permits and encourages the early integration of design concepts with manpower, personnel, training, and related logistics considerations so that their mutual influence can result in a cost-effective, supportable system. It also fosters the integrated development of a manpower, personnel, training, and technical data subsystem that will support effective operation and maintenance of the weapon system in the field.

Designed-In Supportability: A Development Goal



Timely Combat Support is the Objective

Title: **Maintenance Demand Metrics - Phase III**

AFHRL Contact: Frank A. Maher
AFHRL/LRLR
Wright-Patterson AFB OH 45433
Commercial (513) 255-3611
AUTOVON 785-3611

Description: This work was the final phase of an effort to develop better predictors of maintenance demand rates for aircraft. Earlier work developed regression equations that predict maintenance demand rates for aircraft subsystems as a function of environment, design characteristics, and operational requirements. The current work developed equations that are specific for each type of aircraft (i.e., tactical, bomber, and trainer) and for each type of subsystem (e.g., bombing-navigation, landing gear, engines). The new work also investigated the causal relationships underlying the regression equations. These relationships were based on data collected from 61 Air Force bases.

Utilization: The new regression equations that are specific to type of aircraft and to type of subsystem will provide much more precise and accurate predictors of maintenance demand rates with those based on the traditional "flying hour" or "sortie rate" metrics. These results will be used by Logistics Composite Model (LCOM) teams in forecasting maintenance manpower requirements and by aerospace industry personnel involved in new aircraft system developments.

Benefits: The metrics developed in this program provide the necessary computational equations and supporting information to enable the user community to apply them immediately to aircraft maintenance demand estimation problems. These methods are applicable to and will provide increased sensitivity in prediction and estimation efforts for manpower determination studies, cost-of-ownership studies, new basing and deployment planning, and design trade studies for aircraft systems under development. This methodology also provides a quantitative input to the performance of comparability analyses required in the prediction of maintenance demands for developing weapon systems.

Maintenance Technicians Performing a Diagnostic Evaluation of Failed Equipment

Title: **Improving Maintenance Diagnostics**

AFHRL Contact: Capt Walter C. Williams, or Alan E. Herner
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AUTOVON 785-3771

Description: This research will sort out the many causes of diagnostic problems associated with the use of built-in tests in current and future weapon systems. The study will consist of two major phases. The first phase will be devoted to (a) developing a method to accurately and efficiently estimate the number of diagnostic errors (both missed faults and false alarms) which occur at each level of the maintenance process (pilot, flightline, intermediate shop, and depot), (b) developing a practical method to ascertain the causes of diagnostic errors (poor communications between operator and maintainer, inadequate training, inherent design flaws, equipment out of calibration, incomplete technical data, etc.), (c) quantifying the contribution of each of the causes to the overall problems of high diagnostic error rates, sortie impact, and increased support costs, and (d) developing corrective measures to reduce diagnostic errors on fielded and future equipment. The second phase will apply the corrective measures from Phase One to fielded equipment. This field test will provide a conclusive test of the usefulness of the methods developed.

During 1982, a concept study was performed to test major portions of the proposed research approach. This concept study focused on a single line replaceable unit (LRU), the low power radio frequency (RF) of the F-16 radar, and included three major phases. First, a simulation model of the low power RF maintenance process was developed using real-world values of key parameters. The effects of re-test OK of the LRU at the flightline and of false pulls at the intermediate level of maintenance on support costs and on sortie generation have been evaluated with this model. The model also identifies key decision points in the maintenance process through use of sensitivity analysis. Second, the model was used to evaluate the usefulness of existing maintenance data through the Maintenance Data Collection System for evaluating diagnostic decisions. All maintenance records on all F-16 radar LRUs from three CONUS bases were analyzed through the centralized data system developed by the Systems Program Office (SPO). These records were subjected to various statistical analyses and organized to reveal differences in Computer Aided Design/Retest OK data rates by base and by test station/ operator. A failure classification scheme was also developed to correlate pilot-reported malfunctions and built-in test failure indications with subsequent maintenance actions. Finally, alternative approaches for performing field experiments on maintenance diagnostic decision making were examined. A role play technique, with the experimenter acting the part of the pilot in a simulated debriefing, was developed and field tested at MacDill AFB. Debrief and flightline radar technicians were subjects. Technician performance was scored in terms of information solicited from the "pilot" and as a function of the ambiguity/ difficulty of the initial malfunction.

Findings from these three research approaches will form the basis for subsequent efforts. Fruitful approaches will be modified and expanded for inclusion in the larger follow-on study.

Utilization: The research will greatly enhance Air Force logistics long range planning goals. It will aid in establishing a two-tier maintenance concept. "Cannot duplicate" and "retest OKs", as well as spare requirements, could be drastically reduced.

Title: **Logistics Analyses for the Integrated Communications Navigation Identification Avionics System**

AFHRL Contact: James C. McManus
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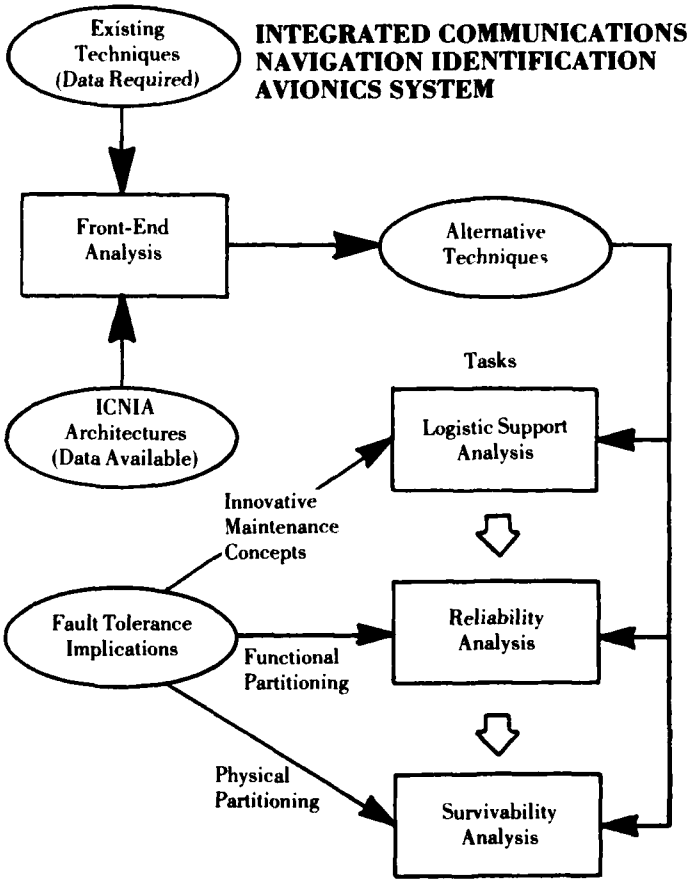
Wright-Patterson AFB OH 45433
Commercial (513) 255-3611
AUTOVON 785-3611

Description: The objective of this effort is to identify tools and techniques for incorporating logistics engineering parameters into system design during the conceptual phase. These analysis techniques will be demonstrated by applying them to the front-end analysis portion of the Integrated Communications Navigation Identification Avionics (ICNIA) system conceptual phase. Among the unique problems being addressed is the development of analytic reliability analysis techniques for graceful degradation. The work will include three major tasks applied to two conceptual ICNIA system architectures developed by the Air Force Avionics Laboratory. Incorporated into these tasks is a front-end analysis to determine the problems associated with logistics engineering during the conceptual development of new avionics and to identify the techniques needed to accomplish the analysis. The three major tasks involve developing front-end analysis techniques in the area of logistics support, reliability, and survivability and applying them to the architectures of the two ICNIA systems. A users' handbook and guidance document will be prepared addressing the rationale and logic behind the analyses identified and developed and providing sufficient detail and clear guidance for use of these analyses.

Utilization: The results of this effort will provide guidance concerning analysis techniques plus indicators of logistics support, reliability, and survivability for the two (ICNIA) system architectures. The technology and the analysis technique developed will be used by government and industry engineers to evaluate the impact that various conceptual design elements will have on equipment reliability, maintainability, and survivability. Through these efforts, it is expected that logistics considerations will affect the final design of the equipment. If the present program is successful, transition of the technology to other programs will be recommended.



Title: **Analysis to Improve the Maintenance Environment**

AFHRL Contact: Richard E. Weimer
AFHRL/LRLC
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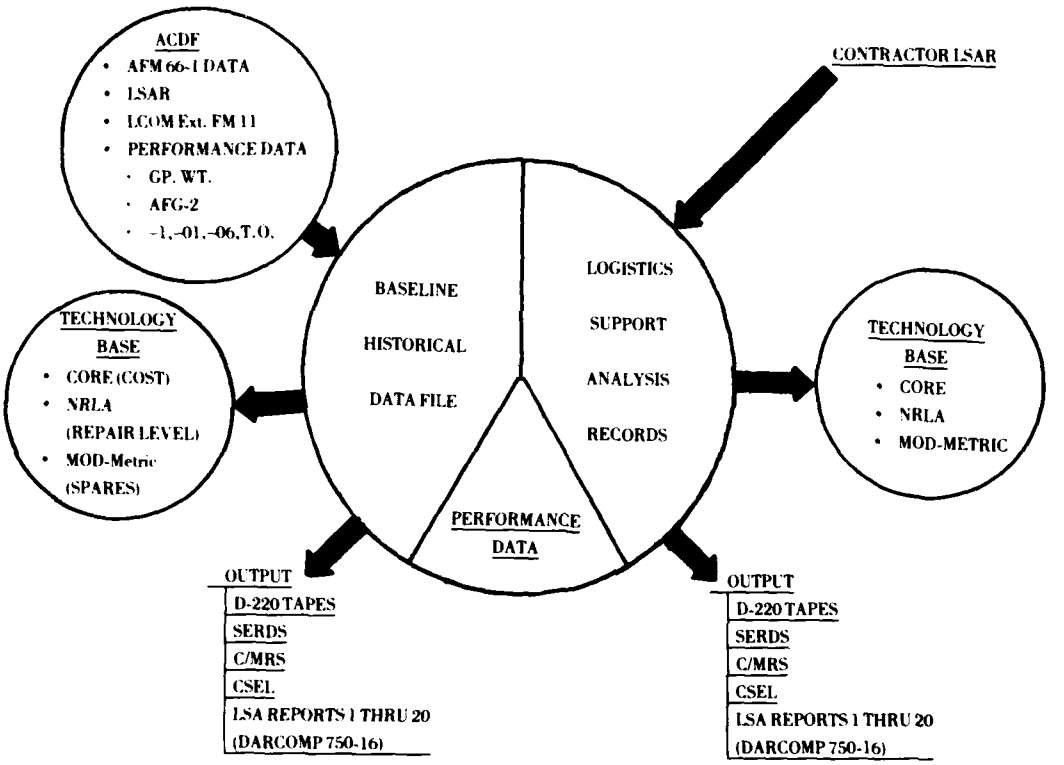
Commercial (513) 255-5169
AUTOVON 785-5169

Description: Good maintenance is an extremely important factor in determining the safety, cost, and operational effectiveness of Air Force weapon systems. This effort is an attempt to identify the most important factors that impact the performance of individuals, groups, and organizations performing aircraft and missile maintenance. The approach of the study is to look at the problem from the perspective of the people who are actually performing, supervising, and managing maintenance operations in the field. This is being done by conducting open-ended, one-on-one interviews with maintenance

personnel representing active duty aircraft, missiles, and the Air Reserve forces. The scope of the interviews ranges from senior management personnel down through the working level technician. All the major commands, including overseas forces, are represented, and interviewees are selected to represent different specialties, weapon systems, locations, skill levels, and maintenance environments. The study is an application of an integrated approach to the maintenance area, with special attention to the role of the human in effective, efficient maintenance. It will provide the basis for an integrated research, development, and applications plan that will be based on the factors that influence maintenance performance as perceived by those who are most directly involved in maintenance work.

Utilization: At the present time, all data collection has been cor pleted for active duty aircraft and missile organizations with approximately 1470 aircraft maintenance people and 220 missile maintenance people having been interviewed at 21 different bases in the CONUS and overseas. Data collection in the Air Reserve is expected to begin shortly. A categorization/ coding scheme has been developed, based on the content of the interview data collected. Data are being coded and stored in a computer data base, and a software program has been developed to allow great flexibility in manipulating and analyzing the stored data. Data analysis is now underway and will be the basis for identifying (a) opportunities for the application of existing technology to improve maintenance and (b) problems that require research or development in order to arrive at and test a solution. Opportunities for technology applications and research and development needs will be prioritized, and a general plan addressing the most important opportunities and needs will be developed. This plan will be shared with all appropriate agencies with the aim of developing an integrated research, development, and applications program for the improvement of Air Force maintenance. Those solutions that can be implemented through policy and procedural changes will be presented to the management of the responsible organizations.

Maintenance Team Installing External Fuel Tank



UNIFIED DATA BASE

Title: **Unified Data Base Technology**

AFHRL Contact: Robert N. Deem
AFHRL/LRLA
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Commercial (513) 255-3771
AUTOVON 785-3771

Description: A unified data base (UDB) technology is being developed for a central automated source of logistics data drawn from basic Air Force systems to support the weapon system design process. Logistics data are those that would assist in obtaining answers to questions about logistics requirements as a function of alternative design/support concepts. Logistics data relate directly or indirectly to reliability, maintainability, ground support equipment, built-in test equipment, task analysis, skill level, skills, crew size, training requirements, technical data, and spares. The basic data systems for this technology are the Logistics Support Analysis Records (Military Standard 1388), and Maintenance Data Collection System (Air Force Regulation 66-1). The UDB is programmed for computer availability and a variety of data output modes is available to the user. The feasibility of this technology has been established. This entailed developing an initial definition and a concept of operation. The technology has been developed and tested and will be evaluated later.

Utilization: This technology and the resulting enhanced availability of logistics information will allow for a significantly increased consideration of logistics factors throughout the weapon system design process. A significant decrease in logistics costs for modern weapon systems should result. The technology developed in this effort will form the basis for an Advanced Development Program that will build on this technology base and will also address Air Force Test and Evaluation Center needs, computer-aided design interfaces and cybernetic techniques and applications. The resulting unified data base technology will be tested and demonstrated on a representative weapon system acquisition program. After testing, it will be transitioned to the Air Force Acquisition Logistics Division where it can be provided as a government furnished program to weapon system contractors for their use in weapon system development. It will also be transitioned to the Air Force Logistics Command for use as a product performance feedback system.

In-Shop Maintenance Aids

Title: **Computer-Based Maintenance Aids for Technicians**

AFHRL Contact: David R. Gunning
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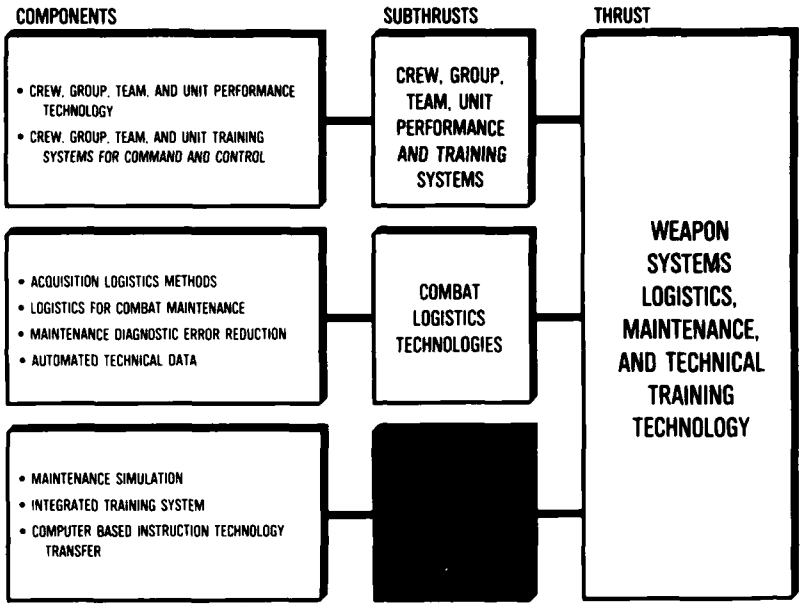
Commercial (513) 255-2606
AUTOVON 785-2606

Description: A prototype computer-based maintenance aids system is to be developed and evaluated. The system will store, retrieve, and present information for use by technicians who perform maintenance tasks at the intermediate level. The goal is to develop a system that is easy to use, is liked by technicians, and provides the technician with all of the information needed for the task. Human factors requirements are being emphasized in the system design. The system will present instructions at three levels of detail. This feature will provide technicians with instructions that are appropriate for all levels of experience (very detailed step-by-step procedures with illustrations for inexperienced technicians, less detailed instructions for more experienced technicians). A computer graphics terminal will be used to present the technical data. The presentation of data on the prototype system will be controlled by a mini-computer. Software for the system will be adapted from the Advanced Instructional System software. Technical data for a test bed system will be developed and placed on the prototype system. The prototype will be evaluated by technicians in an intermediate level shop. The system will be evaluated by measuring the effectiveness of technicians using the prototype system in performing maintenance on the test bed system.

Utilization: The results of the evaluation will be used in developing system specifications for the procurement of a technical data system for the B-1B aircraft, which is in development. In addition, the technology developed in this project will provide the basis for development of an effective technical data presentation system for the Automated Technical Order System (ATOS) at the Air Force Logistics Command. The technology will ensure that the ATOS data presentation system is easy to use and meets the needs of the maintenance technician for technical data. The operational use of a computer-based maintenance aids system will significantly reduce the costs of maintaining the Air Force technical order system by reducing printing costs and reducing the cost of updating technical orders.

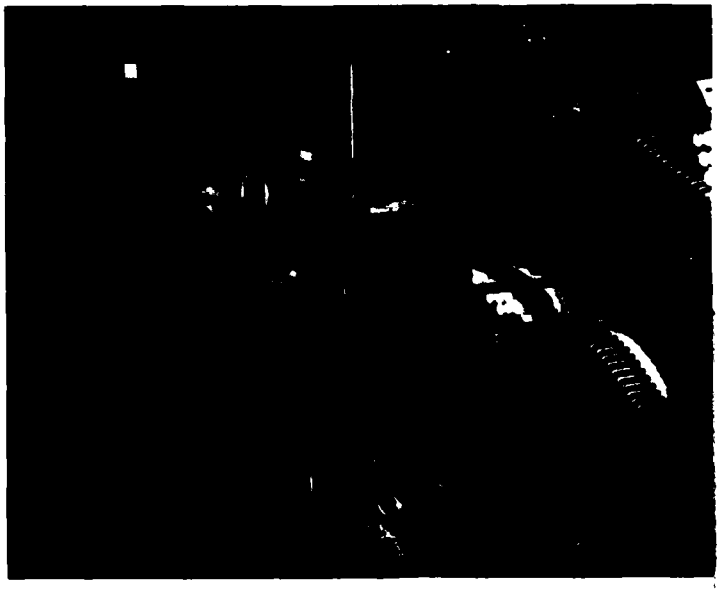
Automated Technical Orders



Title: **Development of Specifications for an Integrated Training System for Air Force On-the-Job Training**

AFHRL Contact: James R. Burkett
AFHRL/LRTT
Lowry AFB CO 80230
Commercial (303) 370-4388
AUTOVON 926-4388

Description: A system definition study of Air Force On-the-Job Training (OJT) has been conducted and a functional description prepared for design and development of a new integrated OJT evaluation, management, and delivery system. This research identified requirements and functions at all levels of the OJT program and alternative approaches to meeting the requirements and performing OJT system functions. Also, a primary prototype system was defined, along with alternative systems, to meet the needs of the Air Force OJT program. Finally, by means of trade-off analyses, a detailed system description was produced for a new OJT system approach. This documentation will subsequently be used to develop a statement of work for an integrated training system for the development, management, delivery, and quality control of OJT. This effort also included a cost-benefit analysis of the proposed system and a site selection alternatives analysis.



On-the-Job Training

Utilization: The present effort will result in functional and design specifications for a new OJT system. The following benefits are anticipated from the implementation of such a system: (a) better techniques for systematic definition of task training requirements and improved task evaluation procedures for OJT, (b) the use of state-of-the-art instructional technology in the OJT setting, (c) the introduction of computer-supported scheduling, record-keeping, testing, and training management into OJT, and (d) the development of OJT cost and capacity models. In general, the system to be developed will be useful to managers at all levels of the OJT program, in both maintenance and non-maintenance areas, from base level up through Air Staff.

Benefits: Requirements documentation, trade studies, system functional description, schedules, and related reports will be used to prepare a development package for subsequent procurement of the integrated training system prototype. This follow-on system development and demonstration effort will be conducted at an operational Air Force base.

Title: **Task Proficiency Evaluation in Air Force On-the-Job Training**

AFHRL Contact: Capt Richard T. Dineen
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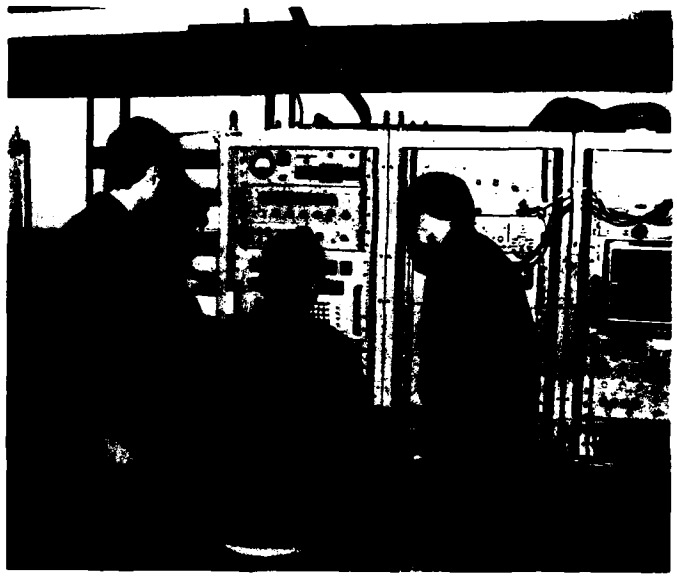
Description: Task-level proficiency evaluation procedures were developed and specifically oriented to on-the-job training (OJT) requirements for both maintenance and non-maintenance applications. These procedures were intended to provide operational guidelines for new approaches to OJT evaluation. The evaluation procedures that were developed have been described in handbooks for use by OJT administrators and by supervisors in designing task proficiency evaluations.

Utilization: There is a recognized need for better operational procedures to determine whether individual trainees in OJT programs have attained necessary task proficiency. Current OJT task proficiency evaluation procedures are not as objective and standardized as they should be.



Avionic Skills Evaluation

This effort explored and tried out new alternatives for OJT task proficiency evaluation designed to meet the needs of OJT trainers and supervisors in the field. The technique selected for further development involves the application of critical incident analysis, and it has been outlined in handbooks for further validation and application. The evaluation instrument developed by this procedure is task specific and is to be used by four distinct levels of users. The first of these is the trainee; because the evaluation instrument is task specific, it can be used by trainees as a self-test of their ability to perform the task. The second level of user is the assigned OJT trainer; the evaluation instrument allows the trainer to determine trainee proficiency in terms of observable activities. The third level of user is the supervisor; because the evaluation instrument is task specific and identifies observable activities, the supervisor can use it as a task proficiency measure. The fourth and final level of user consists of those responsible for determining the current state of OJT training efforts and the qualification levels that result from those efforts; users at this level would be OJT managers and administrators, quality controllers, standardization and evaluation personnel, and evaluators and inspectors at all levels.

Benefits: Procedures developed in this effort will be validated and refined in a follow-on study for further research use and operational try-out. The techniques developed have potential application to task proficiency evaluation in the Integrated Training System Advanced Development project.

Title: **Development of Testing and Instructional System Based on Microterminal and Microfiche Devices**

AFHRL Contact: Brian Dallman
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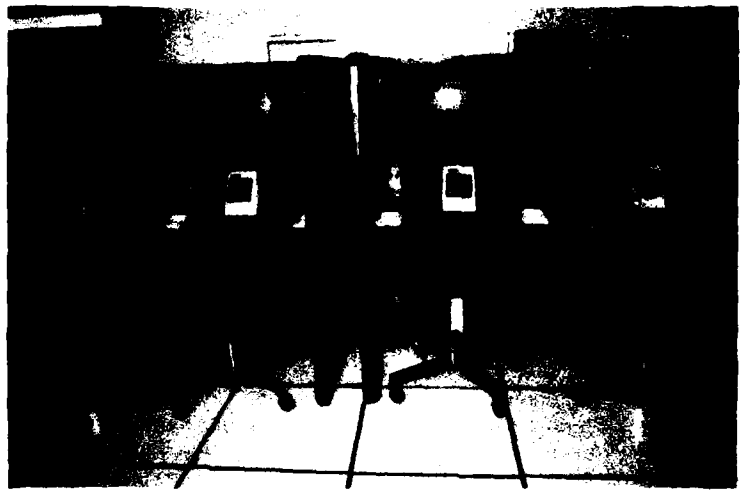
Description: Previous research showed that the use of a small, inexpensive, stand-alone terminal could be used to support testing in a computer-based system such as the Advanced Instructional System. The advantage of such a terminal is both instructional and economical. Results indicated that the process of answering test questions using the microterminal, rather than computer-readable test forms, affected the speed and accuracy with which students complete a test. Over an amortization period of 5 years, a capital investment in low-cost terminals would effect a savings of the recurring material costs associated with test forms.

The present research effort was directed toward extending the knowledge base. A basic design assumption for the microterminal was that computing power should be focused on student responding, rather than on the presentation of information. It was felt that for most instructional purposes, the presentation of information could be as effectively handled by more traditional means of off-line presentations, such as programmed texts. However, the powerful instructional technique of branching becomes difficult to implement with printed materials. For this reason, the two-dimensional accessibility feature of microfiche was seen as desirable. Additionally, in a large computer-based instructional system, the production of microfiche materials is a very direct process through the use of computer output microfiche (COM).

A previous study of COM production techniques showed that COM was a feasible training technology. The essence of the present effort was to combine the computer technology of the microterminal, which focuses on the control of student responding, with microfiche technology, which provides ready access to diverse frames of instructional information. A hardware interface was designed to allow the microterminal to "know" which microfiche frame is being used by the student. The microterminal contains the instructional information on the microfiche. Software packages were developed to allow the microterminal to be linked with a low-cost microcomputer. The microcomputer can handle test generation and record-keeping activities for a testing center when computer-based instruction capabilities were not available. The device has now been developed.



Computer-Based Instruction/Testing

Utilization: Although the Microterminal/Microfiche System is only at the prototype stage, it is seen that fully operational units could be used in both resident and field training courses, for support of Extension Course Institute materials, and in large-scale testing operations such as enlistment testing.

Benefits: The potential benefits of this technology are the reduction of computer form costs for computer-based instruction, provision of interactive instruction for either computer or manually managed individualized courses, reduction in instructional materials costs through utilization of micrographics technology, and increased testing capabilities, including test security.

Title: **Individualized Student Pre-Course Skill Training for Computer-Managed Instruction**

AFHRL Contact: Robert H. Summers
AFHRL/LRT
Lowry AFB CO 80230
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AUTOVON 926-3391

Description: Seven training modules were developed from an analysis of technical training students' role requirements. The resulting Student Motivational Skill Training Package was evaluated in the Precision Measurement Equipment (PME) course at Lowry AFB. The modules were designed to improve the ability of technical training students to cope with student roles and with matters of self-concept in general. The modules were administered to a group of students on the second shift of the PME course. Evaluation of the results indicated that those students scored higher on the first two end-of-the-block tests and had fewer block failures than did a control student group (first shift) who did not complete the motivational skill training. Conclusions drawn regarding the contribution of the motivational skill modules to the superiority of the experimental group must, however, be limited by the presence of certain variables. Special training was given to the instructors of the experimental group and may account for some of the superior PME course performance of that group. In addition, the equality of the two student groups was not established to such a degree that clear-cut comparisons can be made.

Utilization: Results of this study indicate the possibility that training can be developed to improve the basic cognitive and coping skills and motivation of technical trainees', thus enabling them to work more efficiently at learning.

Benefits: The potential payoff to military technical training is extremely high, both in terms of increased efficiency and effectiveness of the training and in the fact that positive changes in attitude and coping skills will not be limited to the training environment. Requests for these motivational skills modules have come from both military and civilian education and training organizations. The primary user will be the Air Training Command, but Navy and Army technical training organizations have also begun use of the motivational skills modules.

Title: **Computerized Adaptive Measurement of Achievement**

AFHRL Contact: Roger Pennell
AFHRL/LRT
Lowry AFB CO 80230
Commercial (303) 370-4388
AUTOVON 926-4388

Description: The objective of this basic research project, jointly funded by the Army, Navy, and Air Force, was to explore issues related to computerized adaptive testing. This research area has received tremendous interest over the past years due to decreased computer hardware costs and the articulation and development of item response theory. Item response theory formulates a mathematical model which describes the probability of a correct response to a test item. This probability function, known as the item characteristic curve, can have as many as three parameters in its basic form. These three parameters are item difficulty, discrimination, and guessing factor, which describe how the item characteristic curve varies as a function of the ability of the test taker. Item response theory leads to a generalized theory of testing having many powerful implications for the measurement of ability and achievement. When combined with increasingly less costly computer systems, it has the potential to significantly improve the testing inherent in Air Force training.

Computerized Adaptive Testing

Utilization: This long-range research effort has resulted in the publication of more than 40 technical reports. One of the recent research topics is a study of feedback and pacing on ability test performance. This study indicated that ability estimates were unaffected by knowledge of results, testing strategy, or pacing of item presentation. A second topic was a comparison of adaptive and conventional testing strategies for mastery testing. This study concluded that variable-length adaptive mastery tests can provide more valid mastery classifications than optimal conventional mastery tests, while reducing test length an average of 80 percent. A third topic was a study of the psychometric characteristics of an adaptive testing strategy for test batteries. Results showed that test battery length can be reduced by 40 to 50 percent using adaptive item selection within subtests.

Benefits: This research holds promise for dramatically improving the measurement of training outcomes in Air Force programs. Testing and measurement in training typically consumes a substantial proportion of the overall training requirement. The procedures derived from this research can increase the precision of training measurement while markedly reducing the amount of time required to accomplish it.

Title: **Handbooks and Model Specifications for the Design and Development of Maintenance Simulators**

AFHRL Contact: Edgar A. Smith
AFHRL/LRTI
Lowry AFB CO 80230
Commercial (303) 370-3391
AUTOVON 926-3391

Description: This study will collect, analyze, and document data to develop a set of introductory handbooks for Instructional System Development (ISD) teams and Training System Acquisition Managers involved in requirements development, design, and procurement of maintenance simulators. Model functional specifications will be developed for the design of both organizational and intermediate level maintenance training simulators for utilization in resident school and field training environments.

Design Guides Aid in Simulator Development

The approach used involves the collection, analysis, and documentation of information on the design, fabrication, and life-cycle maintenance of maintenance simulators. Through a process of information requirements analysis, techniques and decision aids are being developed, based on an analysis of maintenance task classifications. Design guides/handbooks and model specifications are also being developed. An ISD handbook provides procedures for (a) determining the most effective mix of training equipment (trainers primarily used by students to practice required task/part-task activities) for all types of maintenance training requirements, (b) prescribing the most appropriate design features and trainers, and (c) documenting maintenance simulator design so that it can be efficiently translated into a procurement specification by Training Device Acquisition Manager in the Systems Program Office (SPO).

A separate model specification/handbook will be developed for SPO personnel providing a "fill-in-the-blank" model specification and a handbook providing background and information relevant to the specific simulator features and design considerations. Additional handbooks are being developed covering logistical support considerations during the life-cycle of simulators. A SPO handbook for flight simulators is also in development.

Utilization: It is anticipated that the resultant documents will be useful to ISD teams during the development of training specifications for maintenance simulators. SPO activities also will use the documents in the translation of the training requirements into equipment specifications in such a way that efficient and effective training devices will result. Collectively, these documents facilitate the determination of whether a trainer is needed. If a trainer is required, they facilitate the precise documentation of training requirements, the equipment required to support that training, the logistical support that might be anticipated over the life-cycle of the training, and the impact of design decisions on those life-cycle costs.

Initial users are the Test and Evaluation Squadron of the Air Training Command at Edwards AFB and the Simulator Systems Program Office at Wright-Patterson AFB. The publications are also being used by other Air Force, Navy, and Army agencies. They could be used by any agency developing a training program that includes hands-on practice.

Title: **Specification of an Ultrasonic Non-Destructive Inspection Trainer**

AFHRL Contact: Robert H. Summers
AFHRL/LRT
Lowry AFB CO 80230
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Description: Ultrasonic non-destructive inspection (NDI) technology is used widely for the investigation of structural integrity of airframes, aircraft engines, and aircraft hardware components within both military and commercial aviation. Recent wide-scale performance testing has resulted in serious allegations challenging the previously accepted ability of Air Force NDI technicians in the field to find flaws in aircraft structures with the precision and reliability demanded by aircraft design engineers. As a result, the Air Force has identified two urgent needs: an analysis of relationships between NDI performance and other data on NDI personnel and a capability for technicians to practice the ultrasonic NDI technique in Air Force field laboratories. These needs are the two objectives of this effort.

Non-Destructive Inspection Trainer

A preliminary analysis has revealed no significant relationships between NDI performance and both Armed Services Vocational Aptitude Battery (ASVAB) and questionnaire-generated personnel data. Regarding the other project objective, a two-phase study was undertaken to produce a detailed specification of a prototype trainer to be used to develop, measure, and sustain the operational proficiency of Air Force NDI technicians in use of the ultrasonic technique. Phase I, which describes the performance characteristics of the trainer and the behaviors to be developed and sustained by the trainer, is complete. The second phase will specify the engineering/physical characteristics the trainer must have in order to provide those functional requirements identified in Phase I.

Utilization: This project will yield a complete and detailed set of specifications for an ultrasonic NDI trainer. The ultrasonic technique has an increasingly wide application in both military and civilian sectors. Specification of the ultrasonic NDI trainer in this study will enable acquisition agencies to acquire a prototype article. It is anticipated that acquisition of such a trainer will improve the reliability of ultrasonic inspections within aircraft maintenance programs, ultimately effecting safer, less costly Air Force ground and flight operations.

Title: **Standardized Instructional Software in Support of Technology Transfer**

AFHRL Contact: Alan P. Marshall
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Lowry AFB CO 80230
Commercial (303) 370-2775
AUTOVON 926-2775

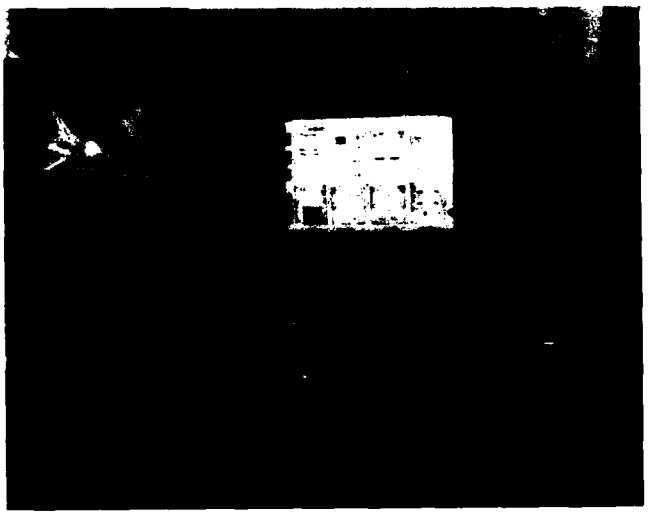
Description: AFHRL has developed a computer-based instructional (CBI) system employing both computer-aided instruction and computer-managed instruction techniques. It is a large-scale system requiring a specially modified Control Data Corporation CYBER computer for operation. The system was originally designed to support a very large number of students in a variety of different training courses and, simultaneously, to support research efforts involving technical training issues. Research and development has now progressed to the point that transfer of this technology to the operational community, i.e., major commands, as well as other DoD agencies, is desired. This technology must be in an affordable, maintainable, and current state-of-the-art configuration. This effort will provide that product and at the same time preserve the significant investment that has been made in developing improved approaches to technical training.

Utilization: The principal purpose of this effort is to develop and demonstrate that one or more of the functional components of this CBI system can reside and execute on small, affordable mini/ microcomputers. This will be accomplished by converting the CBI software to a standard high-order language that will be widely available and supportable on a large number of machines. The DoD standard programming language Ada will be used.

Because of the uncertainty as to when Ada will officially be available, a dual approach has been utilized. The original CBI software, written in a locally generated language, will first be converted to Ada source code. Then a Government-owned (Army) software package will be utilized to convert the Ada source to Pascal source, which in turn will be compiled by available Pascal compilers. When Ada compilers become available, this intermediate step can be eliminated, and executable Ada code can be utilized. This approach allows for immediate generation, execution, check-out, and debug of software without having to wait for official Ada to become available. The development machine for the rehosting effort is a Digital Equipment Corporation VAX 11/780. An initial evaluation is planned to determine how the standardized instructional software will function and to explore microprocessor implementation interface with the Tri-Service Instructional Applications Delivery System.

Standardized Instructional Software
Operates on Mini-/Micro-Computers

A mature CBI system with over 10 years of development will be available to a wide range of users. Because of the modular configuration of the standardized software, users will be able to select only those functional capabilities desired. Very small to very large configurations will be possible. Because the system is fully integrated, users can add additional functional capabilities at a later date without having to redo all their previous work. The system will be in Ada; therefore, transportability over a wide range of vendor hardware will be possible. The use of Ada will mean that one common software package will exist, and that it can be maintained for all locations from one control site. The final software product is to be put in the public domain. Commercial, private, and public organizations can use the standardized software as the basis of their own training systems.



Graphics Simulation with Computer Overlay

Title: **Interactive Computer Graphics Simulation for Intermediate-Level Maintenance Trainer**

AFHRL Contact: Edgar A. Smith
AFHRL/LRTI
Lowry AFB CO 80230
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AUTOVON 926-3391

Description: The potential for interactive computer graphics to provide part-task simulation capability for maintenance training is very high. One objective of this effort was to demonstrate the feasibility of using interactive graphics simulation as a cost-effective adjunct in a learning center consisting of a 6883 Converter/Flight Controls Test Station for the F-111 aircraft and a three-dimensional simulation. A second objective was to investigate the training effectiveness of graphics simulation and to develop a functional specification for a low-cost stand-alone interactive graphics learning environment. Other objectives were to explore such issues as color, fidelity, and resolution requirements and to evaluate the use of embedded instructional strategies, such as advanced organizers.

The test bed has been built on the existing research and development capabilities of the computer-based instructional system at Lowry AFB. These capabilities include data collection and analysis computer-assisted instruction, and computer graphics generation. The basic hardware configuration consists of a high resolution color graphics terminal and a video disk unit. The video disk unit is capable of representing a variety of adjunct media (i.e., microfiche, video tape, slides, film, etc.) that could be used for the final design of a simulator.

Utilization: This research will produce a graphics simulation for 6883 test station tasks, specifications for a low-cost device targeted for the training environment, and a research test bed for the resolution of issues associated with maintenance training graphics simulations. Furthermore, the test bed can be considered as a prototype system for establishing functional specifications for a variety of part-task training simulations. Such a system could be used by the Systems Program Office (SPO) in determining least-cost simulations. This effort is extremely important in determining the correct match for a training task and its graphics-level simulation. The results of this effort can be used in 17 developing graphics-level simulations for new weapons systems and equipment, as well as for current systems. This effort will demonstrate and evaluate a simulator with low-physical fidelity, but with high potential for maintenance training, including troubleshooting. Devices and software will serve as a test bed for future investigations.

Title: **Effective Application of Computer-Assisted Instruction Within Different Instructional Settings**

AFHRL Contact: Brian Dallman
AFHRL/LRT
Lowry AFB CO 80230
Commercial (303) 370-3391
AUTOVON 926-3391

Description: The degree to which computer-assisted instruction (CAI) is effective varies substantially from one situation to another. This project is investigating the factors that create those variations in effectiveness, with the goal of establishing predictors of effectiveness of CAI applications. Once all such factors have been so ordered, they will be transformed into a decision matrix; this will ensure that all relevant factors can be weighed in CAI implementation decisions.

Utilization: The ultimate product of this effort will be a course managers handbook that will prescribe the appropriate level of CAI application and will identify the required resources. This handbook is expected to be used for training development decisions in all military technical training. CAI is an effective medium of instruction if appropriately applied. The handbook will provide guidance that will help ensure cost-effective utilization.

Title: **Computer-Based Instructional Technology Transfer**

AFHRL Contact: William A. Nunns
AFHRL/LRTA
Lowry AFB CO 80230
Commercial (303) 370-2775
AUTOVON 926-2775

Description: The value of new technology resulting from R&D is its usefulness to the operational/user communities. The ultimate test of a new technology is its contribution toward developing, supporting, and maintaining a superior combat ready force. There are both formal and informal mechanisms within the Air Force for transitioning new technologies from the R&D community into the operational/user communities. The following are some specific examples of technology transfer being pursued by AFHRL at Lowry AFB:

(1) Department of Energy (DoE) - Two terminals provide computer-aided instruction (CAI) and computer-managed instruction (CMI) to several hundred DoE nuclear materials workers.

(2) Tactical Air Command (TAC) - A successful demonstration of the forward looking resource scheduling system (FLRS) was conducted by TAC using terminals connected to the AFHRL computer at Lowry AFB. The TAC Director of Operations has approved proceeding with the FLRS effort.

(3) Air National Guard (ANG) and Reserve Training - The local ANG Training Office is interested in the extent to which AFHRL computer-based instructional (CBI) software could resolve ANG training problems. Since ANG units normally meet 2 days per month, the scheduling of training absorbs much of their time. FLRS

Computer-Assisted Instruction

software seems appropriate to meet scheduling needs. ANG would like a 30- to 90-day demonstration of this application.

(4) National Security Agency (NSA) - NSA will be using the CBI system at AFHRL/Lowry by the fall of 1982. Four terminals at NSA/ Washington D.C., will be connected to the AFHRL/Lowry computer. This will be a 12-to 18-month effort to allow NSA to develop, demonstrate, and evaluate advanced CBI technologies.

(5) Manpower Personnel Center (MPC) - MPC started using the AFHRL/Lowry CBI system Dec 82, with four to six terminals at Randolph AFB connected to the AFHRL/Lowry computer. Initially, one terminal was on-line and was used for demonstrations and course author training. The MPC effort will also be a 12- to 18-month project that is expected to result in standardized software on an MPC VAX 11/780 computer.

(6) Tri-Service Engineering Development - A tri-service project is aimed at capitalizing on previous R&D technologies to develop a tri-service CBI training device. The approach is to utilize the Navy-developed Electronic Equipment Maintenance Trainer in an enhanced form and the standardized instructional support software being developed and managed by AFHRL/Lowry.

(7) Space Command - The Technical Training Center at Lowry AFB provides training for operator and maintenance personnel assigned to space systems. Personnel at Space Command Headquarters, Colorado Springs, and at the Space Command units at Sunnyvale and Vandenberg AFB, are interested in exploring innovations in this training. The opportunity to apply advanced CBI technology to this training would permit AFHRL to impact space training significantly.

(8) Training in Ada - The DoD Standard Computer Language - The DoD Ada Project Office has been in contact with AFHRL/Lowry to analyze the type of training needed to establish a capability to train thousands of DoD programmers worldwide in the use of Ada. AFHRL is in a position to take the lead in this area and make a major cost-effective contribution to DoD.

The on-going standardized software development at AFHRL/Lowry is directed toward making all of these activities operationally feasible. This project is developing a mini/microcomputer version of AIS written in a standard language. Once completed, standardized software will be available to all DoD users as a transportable, modular, highly flexible computer-based training system.

Utilization: AFHRL/Lowry has agreements with several operational/user organizations to allow them access to the AFHRL/Lowry CBI system. This access will permit these organizations to explore advanced training technology that has resulted from AFHRL/Lowry R&D activities over the past few years. It is anticipated that a carefully planned and systematic transition of advanced CBI technology to the operational/user community will result in improved training and, ultimately, in improved performance.

Title: **Forward Looking Resource Scheduling System**

AFHRL Contact: William A. Nunns
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AUTOVON 926-2775

Description: Because of the increasing complexity of the modern day flight-training syllabus, an inordinate amount of time is being spent in developing daily flight schedules. The objective of the first phase of this project was to reduce daily flight-scheduling manhours by 50% by developing and demonstrating the feasibility of computer-assisted daily flight scheduling.

Computerized Flight Scheduling

The approach was to build the scheduling system around the existing data base and editor approach of the Advanced Instructional System (AIS). Utilizing student, instructor, course syllabus, and schedule data bases, the system assisted the scheduler by producing a basic schedule that was syllabus specific and conflict free. The scheduler then fine-tuned the schedule through an on-line cathode ray tube (CRT). Likewise, to maintain currencies, student and instructor data bases were updated at the end of each sortie. Responding to additional requirements identified during this phase, AFHRL has proposed to the Tactical Air Command (TAC) that a joint effort be initiated to enhance forward looking resource scheduling (FLRS) through the application of existing AIS technology. This would provide historical data collection and analysis, requirements forecasting, reports generation, and academic assistance capabilities.

Utilization: The effort resulted in a demonstrable daily flight-scheduling capability. The feasibility demonstration was conducted

during February 1982 in one squadron of the 479th Tactical Training Wing of TAC at Holloman AFB. In the second phase, which is being proposed as a joint TAC/AFHRL effort, the additional capabilities will be integrated into the system, and the technology will be transitioned to TAC for implementation within a full wing at Holloman AFB. TAC has written a Request for Personnel Research entitled, "Forward Looking Resource Scheduling." TAC has identified three major categories of benefits that would result from full implementation of a FLRS system: direct cost savings - primarily operation and maintenance costs for student temporary duty; time savings - reducing scheduling manhours by two-thirds, allowing people to do what they do best; quality control - eliminating syllabus deviations, improved student training continuity, and reduced unprogrammed direct support missions.

Title: **Tri-Service Instructional Applications Delivery System**

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Description: The objective of Project TRIADS Tri-Service Instructional Applications Delivery System is to develop a microprocessor-based military computer-based training system. This system will be composed of a software library and a modularized expandable hardware configuration. The system will be capable of selected simulation, instructional delivery and management functions, and instructional materials authoring while operating in a stand-alone mode. It will have the capacity to be networked to a larger system for larger-scale training operations, may be interfaced to panel simulators for high fidelity simulation, and will have an expansion capability to increase its functional capabilities. The system will be designed so that potential features may be evaluated and incorporated in future designs. These features include envolving technologies such as voice synthesis and recognition. This is a tri-service program. AFHRL has the program management responsibility, as well as responsibility for contract efforts to determine user requirements and to interface standardized instructional software to the TRIADS hardware.

Utilization: Because it is modularized and expandable, TRIADS is adaptable to most military training situations. It will serve as a low-cost simulation device for maintenance training tasks requiring two-dimensional and/or three-dimensional simulations. TRIADS can be configured to deliver computer-assisted instruction to a number of simultaneous users, and will perform many instructional management functions. TRIADS has relevance to a variety of military training operations. It will embody the demonstrated capabilities of military R&D efforts in the areas of maintenance simulation and computer-based training. These capabilities will allow for increased training effectiveness, enhanced instructional management efficiency, and the possibility for effective job-aiding applications which will produce a corresponding increase in force readiness. There is a reasonable potential for cost-savings that would warrant large-scale implementation of production versions. TRIADS will reduce the proliferation of single purpose training systems and the associated maintenance, configuration management, and support problems.

Title: **Artificial Intelligence Applications in Training, Job Aiding, and Performance Assessment**

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Description: The Air Force has been interested and involved in artificial intelligence (AI) research for some time, but practical applications in this field have been limited because of expense and a lack of development tools. This situation is changing, and as a result, interest is growing. AI is the study and application of what is known about intelligent behavior to the development of machine systems, especially computer systems. This effort will conceptualize a program plan for the development, validation, and implementation of AI applications which will help solve Air Force problems in the areas of technical training, performance assessment, and job performance aids.

Job Aids with Embedded Artificial Intelligence

Utilization: This initial effort will develop a program plan for AI applications. It will serve to integrate and coordinate AFHRL plans with other military R&D agencies and will help keep the user community informed concerning AFHRL planning. It will also inform contractors of Air Force problems, needs, and planning. A comprehensive, unified, and coordiated plan can enhance R&D program responsiveness by reducing duplication of effort, promoting sharing of resources and products, and encouraging program support from the user community.

Title: **Development of a Flight Simulator Troubleshooting Trainer**

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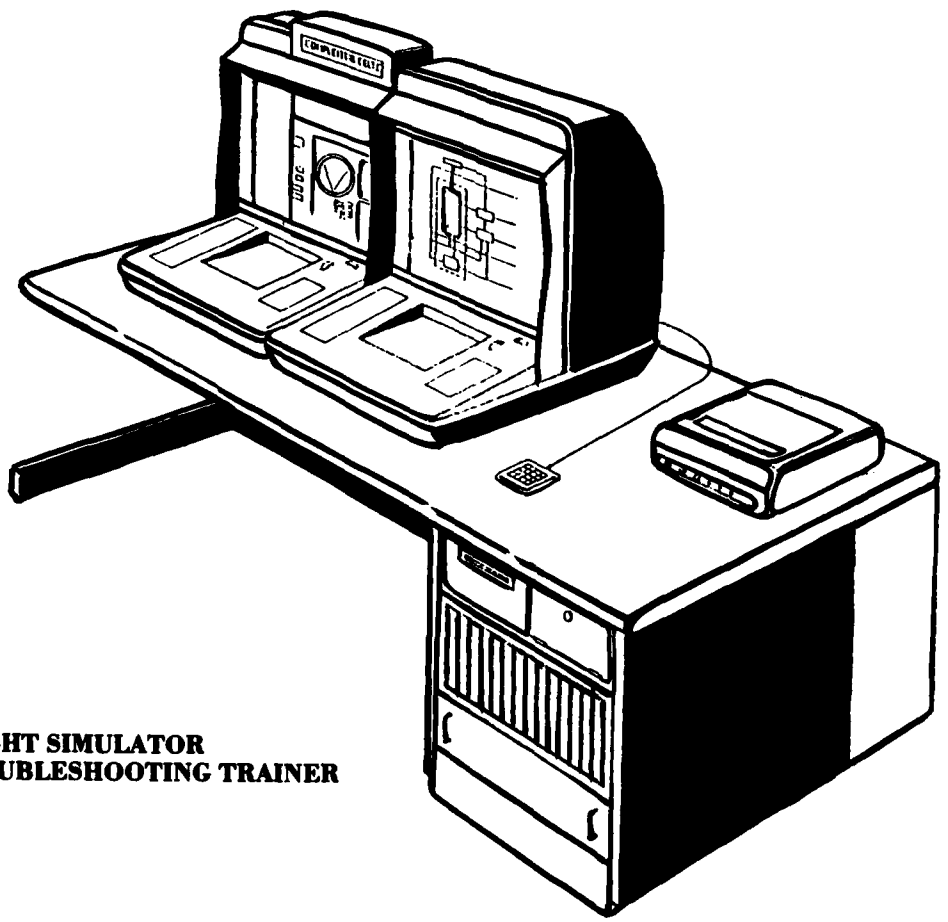
Description: Because of the increasing aircrew training demands on flight simulator availability, maintenance personnel have less of an opportunity to use the flight simulators for maintenance training. To fill this ever-widening gap between maintenance training requirements and training capabilities, a prototype troubleshooting trainer has been developed and is being evaluated in the field. The trainer provides technicians with a substantially improved capability for hands-on practice in troubleshooting many of the more frequent malfunctions in the flight simulator. The trainer models the major subsystem components of a representative flight simulator, with emphasis on the functional and logic flow relationships of the components, and provides a wide range of simulated malfunctions for technician troubleshooting practice.

To further enhance the overall effectiveness of the trainer, additional instructional features, such as automated performance measurement and automated student feedback, are incorporated in the device. The device is currently being utilized by the 380th Aircraft Maintenance Squadron (AMS) at Plattsburgh AFB. The lessons (malfunctions) have been reviewed by that technical staff and suggested revisions accomplished. A formal summative evaluation is underway to investigate the impact of practice on the trainer on subsequent success or failure in identifying and rectifying malfunctions on the actual flight simulator. Lesson summaries are available to the student and supervisor to emphasize the troubleshooting logic required in each lesson. Tentative results obtained during the formative evaluation suggest that learning does result from interaction with the device.

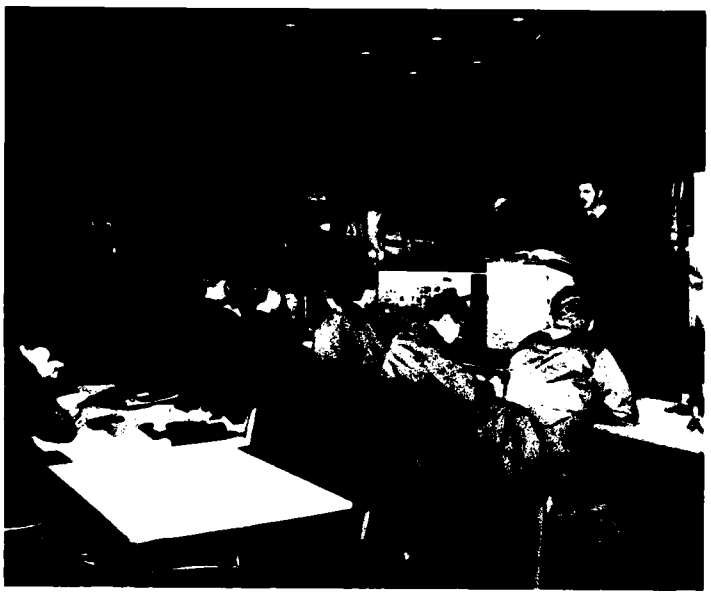
Technicians assigned to the 380th AMS who have utilized the device are able to isolate the cause of the malfunction and identify appropriate corrective action considerably more accurately and quickly on successive trials on the trainer. Having the trainer available at the duty station, as opposed to a training site, appears to have a beneficial effect on the supervisor's ability to train newly assigned personnel.

Utilization: This trainer is being used to train maintenance technicians at the duty station on troubleshooting the F-111 flight simulator, a relatively complex and mature flight simulator. If the approach embodied in the troubleshooting trainer is validated in this initial application, similar trainers could be developed for the full range of present and future flight simulators. The hardware configuration and controlling software

are suitable for troubleshooting training in general and are not uniquely associated with this particular application. New malfunctions and the associated microfiche images would have to be developed for each system. However, the results of this effort may eventually be generalized to other complex electronic systems that are similar to flight simulators in design and architecture when the opportunity for maintenance training is restricted. Improved training of maintenance personnel in troubleshooting complex electronic equipment is being realized.



FLIGHT SIMULATOR TROUBLESHOOTING TRAINER



Job Aids with Artificial Intelligence

Title: **Personnel Requirements for Non-Conventional Instruction**

AFHRL Contact: Robert H. Summers
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Description: This effort is investigating the roles of instructional support personnel in non-conventional instructional (NCI) settings. Questionnaires and interview forms have been developed, and NCI personnel in 10 courses at four Air Training Command centers have been queried. Data are being summarized to determine the range of instructor-perceived problems and instructor roles and behaviors across NCI settings. Roles will be identified for instructors and for non-instructor personnel (aides, proctors, helpers). For each type of NCI environment, qualifications will be derived, and selection criteria and job descriptions will be developed for required personnel.

Utilization: Principal products of this study will be a description of the NCI role model its implications for personnel requirements in each NCI setting and recommendations for selection and training of those personnel. Guidelines for selection and training of instructors in non-conventional instruction will enable those instructors to function with greater success and satisfaction. Recommendations for the selection and training of instructors and non-instructor personnel in non-conventional settings will have universal applicability to both military and civilian non-conventional education and training activities.

Title: **Critical Factors Associated with Self-Paced Instruction Implementation**

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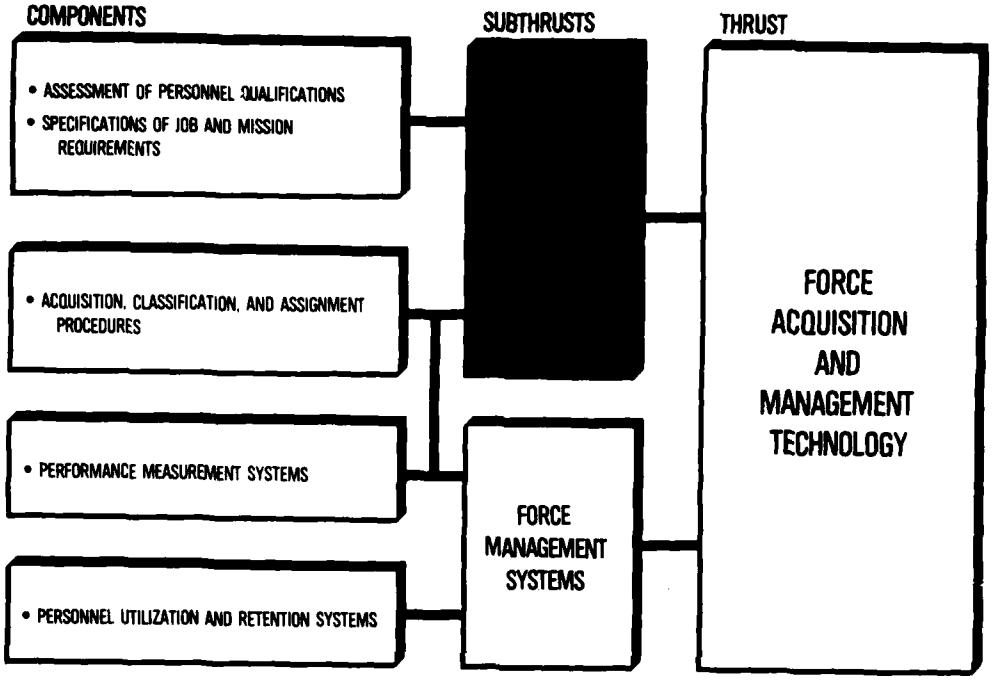
Description: This study was undertaken as a first step to systematically study factors which influence self-paced instructional designs, and specifically to identify those factors that are decisive to the successful implementation of a self-paced course. The approach taken was to identify candidate factors from an analysis of existing military and civilian reports and to employ interview and case study techniques to determining factors for examples of successful and unsuccessful implementation within the Air Training Command. In general, the major findings of this effort were that successful self-paced courses had characteristics that could produce cost benefits. Also, flexible, creative, and knowledgeable managers, as well as high instructor dedication and motivation, are extremely important if implementation is to be successful. Many other design, resource utilization, personnel and student issues were judged to be important.

Utilization: The results of this study will be useful for instructional system designers and personnel involved in the design and implementation of new instructional technologies. By attending to the factors identified in this study, the incidence of unsuccessful implementations of self-paced instructional designs could be reduced.

MANPOWER AND FORCE MANAGEMENT

AF HUMAN RESOURCES LABORATORY

MANPOWER AND FORCE MANAGEMENT THRUST



FORCE ACQUISITION AND DISTRIBUTION SYSTEMS **TECHNICAL ACHIEVEMENTS**

Title: **Evaluation of Aptitude Requirements for Air Force Enlisted Job Specialties**

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Description: Given the all-volunteer recruiting environment and projections of a decreasing manpower pool during the 1980s, it is critical to ensure that occupational aptitude requirements be accurately stated and that available manpower be assigned to those occupations where their talents are most needed. A methodology has been developed to evaluate aptitude requirements which results in measures of learning difficulty for each enlisted job specialty. Initially, learning difficulty is generated on a position-by-position basis and is derived through a task analysis of learning difficulty and time spent performing. To derive an index of the learning difficulty of the entire occupation, learning difficulty is averaged across occupational positions. To date, the methodology has been applied to over 200 enlisted job specialties representing the aptitude areas: mechanical, administrative, general, and electronics. This effort involved on-site observation and evaluation of learning difficulty for over 10,000 tasks by two independent teams of experts and the calculation of learning difficulty for well over 100,000 tasks for more than 170,000 incumbent positions.

Utilization: Measures of occupational learning difficulty provide an empirical, job-centered frame of reference that can be systematically utilized in the evaluation of occupational aptitude requirements. Measures of occupational learning difficulty were delivered to an aptitude

requirements working group consisting of representatives from the Air Force Manpower and Personnel Center, Air Training Command, Air Force Recruiting Service, and the AFHRL. The goal of the working group was to review aptitude requirements for all enlisted job specialties with specific attention devoted to employment of occupational learning difficulty in defining job aptitude requirements. As a result of this review, aptitude requirement adjustments were accomplished for 100 enlisted specialties and were formally implemented in the April 1982 update of Air Force Regulation 39-1. Learning difficulty information has also been delivered to Air Force Recruiting Service where it has been implemented through the computerized job reservation system. In addition to areas of formal implementation, there are three areas of potential application. First, learning difficulty data could be used to redesign or restructure occupations to reduce occupational learning loads. Second, there is potential for training applications. With additional research, it may be possible to design and/or evaluate technical training courses on the basis of the learning difficulty of tasks as they are performed in the field and thereby increase the linkage between job performance and technical training. Third, these data have potential applications in the area of job performance. Knowledge of the learning difficulty of tasks can guide decisions concerning the development of fully proceduralized job performance aids.

Benefits: There are three significant areas where cost avoidance should be achieved as a result of this research. Contingency plans for talent shortages will be available as a product of this effort. These plans will enable the Air Force to compensate for future talent shortages by specialty or across all specialties within an aptitude area. Another extremely important by-product of this research is a defensible position for occupational aptitude requirements in the case of court actions. The present system, prevents many individuals from entering job specialties because they fail to achieve established aptitude score cut-offs. Until the completion of the aptitude requirements project, there were no quantitative data to support the use of the aptitude score cut-offs. Perhaps the single most important benefit resulting from this research is more optimal person-job match. Ensuring that enlistee aptitudes correspond to occupational learning load requirements should have positive effects on job satisfaction, job performance, and retention.

Air Force Specialty Requirements

Title: **Assessment of Physical Strength and Stamina Requirements in Air Force Specialties**

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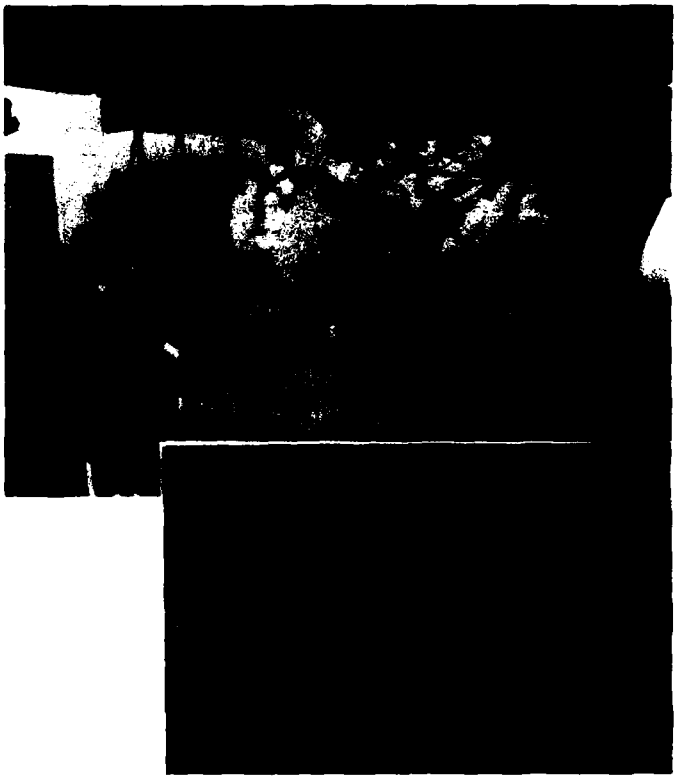
Description: Each Air Force enlisted specialty is presumed to differ in the nature and extent of physical capabilities required for successful job performance. Moreover, in a variety of specialties, effective performance requires above average physical strength and stamina from incumbents. Despite these prevailing conditions, little systematic research has previously been done to support definitive assignment criteria to ensure that personnel capabilities meet or exceed on-the-job requirements. A comprehensive two-stage assessment of the physical occupational requirements in 188 enlisted specialties has now been completed, and final data analyses are underway. Approximately 16,000 supervisors worldwide have rated more than 67,000 occupational tasks for purposes of identifying, defining, and quantifying physical demand requirements within specialties. Results from the first stage of assessment have shown that supervisory personnel can reliably identify and rate physically demanding tasks and thereby provide the empirical base for specialty-specific task demand profiles. These results, along with a framework to use in combining task-level estimates to produce an index of demand for an entire specialty, have been documented in the first of a series of technical reports.

On-going and future research activities include the formulation of regression models to establish the predictive accuracy of specific task parameters and to benchmark and compare demand characteristics across specialties. Moderator variables such as numbers of first-termers performing the tasks, time spent in task execution, and consequences of inadequate performance will be closely studied.

Utilization: Physical demand indices will ultimately be incorporated with the person-job match system as additional factors to be considered for the optimal assignment of individuals to jobs. Further refinement of the algorithm with physical demand factors is especially important in view of current accession trends, namely, declining numbers of qualified male enlistees and the concomitant increase in the proportion of females serving in the Air Force.



Physical Stamina Requirements

Benefits: Definitive physical job requirements can be expected to reduce recruiting costs by expanding the qualified applicant pool (particularly among females) and to curtail medical costs resulting from the assignment of persons to jobs where demands exceed physical capabilities. Using physical requirements data to get the right person in the right job can also mean real-time payoffs in force effectiveness through enhanced productivity on the job, increased job satisfaction, and reduced attrition.

Title: **Reading-Related Problems in the Air Force**

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Description: AFHRL undertook the development and norming of the Air Force Reading Abilities Test (AFRAT) to standardize the assessment of reading ability of Air Force personnel. This test was designed to replace the more expensive and less effective commercial reading tests previously used throughout the Air Force. The goal of this effort was to develop a reading test with appropriate norms for Air Force subgroups.

Two parallel or comparable forms of AFRAT were developed. This reading test consists of 45 vocabulary items in a synonym format and 40 comprehension items consisting of one or several paragraphs followed by one or more questions. The comprehension items require either paraphrasing or making inferences from the written passages. All items are multiple choice with four alternatives and a total test time limit of 50 minutes.

Utilization: Based on norming and validation studies conducted, the AFRAT was implemented in April 1982 as an operational test Air Force wide, supporting many formal training programs and on-the-job training. It is used in Basic Military Training (BMT) to screen and identify poor readers for discharge or remediation. Airmen with reading problems can be identified more accurately, thus reducing the costs associated with training failures due to reading problems.

Benefits: This reading test filled a void. Previously, over 12 different reading tests were used throughout the Air Force, resulting in a problem concerning standardization of test scores. Now, two forms of a single test are used to assess literacy skills. The use of AFRAT provides a better assessment of Air Force student personnel reading ability and allows for comparison of groups across occupations and major commands.

Utilization of AFHRL-Developed Tests

Title: **Equating in Curtailed Samples**

AFHRL Contact: Malcolm Ree
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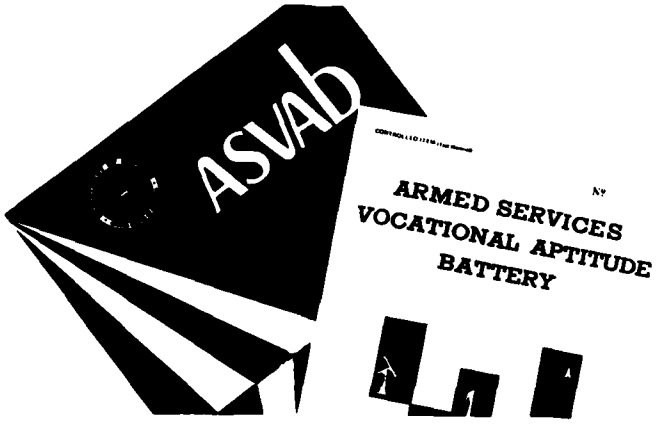
Description: This large effort investigated the effects of equating abilities tests in samples which had their ranges curtailed by selection decisions. Large uncurtailed samples were used as criteria for comparing equatings executed in the curtailed samples. Several levels of curtailment and sample size were investigated as was the use of both equipercentile and linear equating.

Utilization: The procedures developed in this project will provide the techniques to be used in equating test measures for operational testing programs. The first use of this procedure is tentatively planned for the equating of the Armed Services Vocational Aptitude Battery in late 1982.

Benefits: The results of this research provide a clearer understanding of the impact of sample size and curtailment on calibration accuracy. Advances in psychometric theory, such as in the area of equating, ensures that the testing procedures provide the necessary precision for appropriate selection and classification decisions.



Institutional ASVAB Forms

Title: **Development of Composites and Norms for Follow-On Forms of the DoD Institutional Test Battery.**

AFHRL Contact: John Mathews
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Description: Administration of a form of the Armed Services Vocational Aptitude Battery (ASVAB) is offered free to civilian schools for use in guidance and counseling of students. A new form of the institutional ASVAB, which is parallel to the current operational forms, is planned for implementation at the start of the 1984-1985 school year. Three studies were initiated this year by AFHRL in support of the institutional program. In the first study (which has been completed), test composites for the new institutional ASVAB were developed via factor analysis and were empirically related to military service composites. A second study is underway in which the institutional ASVAB measures will be compared to similar measures in each of several commercial test batteries using samples of high school students. A third, on-going study is obtaining school grade and gender norms for ASVAB based on a nationally representative sample from the Profile of American Youth data base. The results of studies involving the institutional ASVAB will be included in a technical manual for the use of school and recruiting service personnel.

Utilization: About one million high school students take the institutional ASVAB annually. Military recruiting commands use institutional testing results to identify and recruit service eligible students who are in their last year of high school. Since institutional ASVAB scores are valid for selection into the services, additional entrance testing at the Military Entrance Processing Stations is not required, thus facilitating the recruitment process.

Title: **Development of Follow-On Forms of the Armed Services Vocational Aptitude Battery**

AFHRL Contact: Malcolm James Ree
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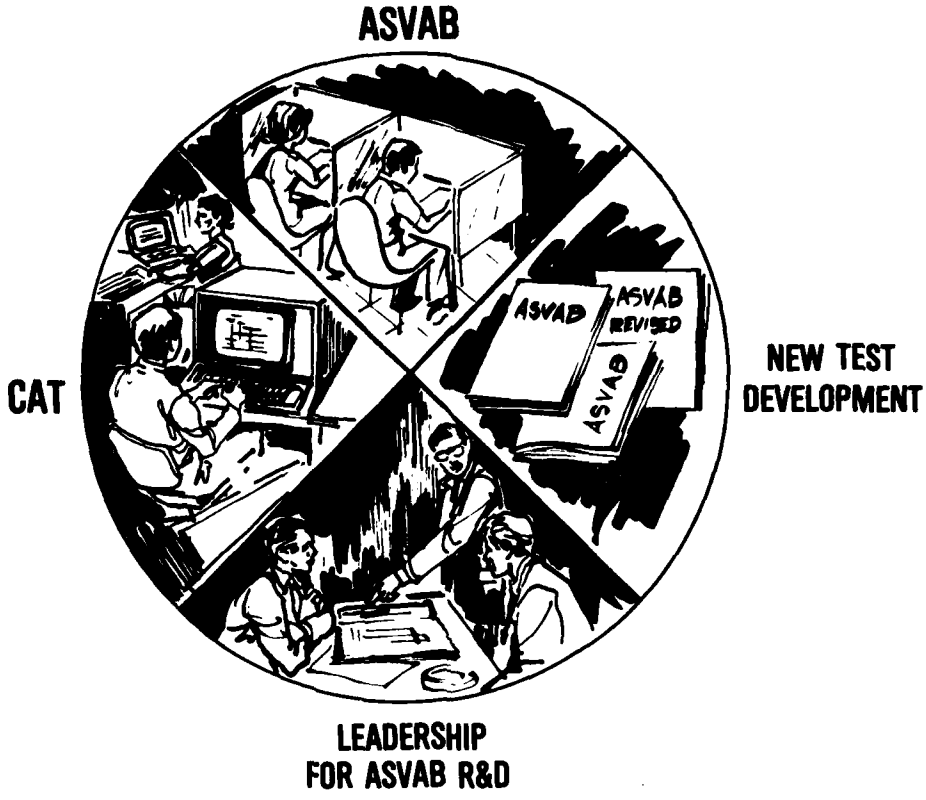
Description: In calendar year 1983, additional forms of the Armed Services Vocational Aptitude Battery are scheduled for operational implementation. Item writing has been accomplished with contractor support, and experimental forms have been constructed and are currently being administered to several thousand recruits of the Armed Services. A contract has been let to provide support for the final calibration of the scores to the normative scale.

Utilization: ASVAB is revised periodically to maintain integrity of the battery and to incorporate improvements. It is used by all of the Armed Services to select and classify enlisted personnel.



Title: **Advanced Research on Adaptive Testing Systems**

AFHRL Contact: Malcolm James Ree
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Description: Traditionally, in the Air Force and elsewhere, uniform standardized aptitude and abilities tests have been given to applicants for employment. Among other characteristics, these tests must be fair and accurate. They must be valid for predicting some useful criterion such as performance in technical training school or performance on the job. When the same test is administered to every applicant, accuracy of measurement is limited to a restricted range about the mean. Without making a test exceedingly long, uniform accuracy across the measurement scale cannot be achieved. Computerized adaptive testing is a name given to a series of techniques for presenting an appropriate subset of items from a very large item pool, thus avoiding the presentation of inappropriate items. The AFHRL is a recognized and respected leader in this field. A goal-oriented series of efforts is underway to develop both prototype and operational item pools as well as to advance the state of knowledge in the theoretical basis of adaptive testing. Among these studies are pioneering efforts in linking of item statistics and analytic derivation of standard errors of advanced item parameters.

Utilization: Adaptive testing is usually based on Latent Trait Theory, and serious gaps exist in the body of theoretical knowledge. These efforts are directed at completing the knowledge as it applies to the Laboratory's responsibility to the Joint Services Computer Adaptive Testing Interservice Coordinating Committee. This research is necessary to achieve the necessary tasking under this commitment. Adaptive testing will eventually be used in developing and norming Air Force operational aptitude tests and by the Air Force Recruiting Service and the Army Military Enlistment Processing Command.

FORCE ACQUISITION AND DISTRIBUTION SYSTEMS

Officer Selection and Classification

Title: **Development and Validation of Officer Selection and Classification Tests**

AFHRL Contact: Lt Deborah Rogers
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Description: A new form of the Air Force Officer Qualifying Test (AFOQT-O) was implemented September 1981. Analysis and evaluation of the developing AFOQT data base will be continued to determine the need for modification or changes in the test format, content, and scoring procedures. Centralized scoring procedures have been established that ensure consistent and error-free scoring. The scoring methodology, response (answer) sheets, and scoring equipment will be under continuous evaluation to detect errors or to improve procedures. A recruiter "quick score" procedure will be evaluated to establish the relationship between quick and final scores of applicants. Development procedures of a new item pool have been initiated.

Utilization: AFOQT-O is used by the selection boards of the Officer Training School and the Reserve Officer Training Corps, in conjunction with other variables, to select civilian and military applicants who are most likely to succeed in training and subsequent career assignments. The "quick score" method provides the applicant with instant feedback about the probability of scoring sufficiently high on the test to meet the requirements pending results of centralized scoring.

Officer Education R&D

Title: **Determining Officer Education Requirements**

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Description: This research effort is designed to develop a method of measuring educational attainment of officers and the educational requirements of officer specialties. Measuring education attainment is achieved through an officer education profile. The profile transforms college transcript data into a standard format consisting of 48 course headings representing management, computer science, social/behavioral science, engineering, physical science, and humanities courses. This format, in turn, became the foundation for two kinds of surveys for administration to job incumbents from 12 different officer specialties. The first survey form presents 50 transcripts coded in the profile format. Each is to be rated on its suitability to the incumbent's job. Data analysis will consist of regression equations using the profile data to predict suitability ratings. The second survey form lists the 48 course titles with their definitions. Incumbents receiving this survey are to indicate the number of courses within each course title that are necessary for successful job performance. Data analysis will consist of developing a synthetic transcript for each specialty to represent the ideal education requirements.

Utilization: The findings of the research will be applied by the Air Force Manpower and Personnel Center to revise the educational requirements for Air Force officer specialties. Revisions will be documented in the Officer Classification Regulation (Air Force Regulation 36-1) and represented mathematically for use in the future officer person-job-match system.

Title: **Validation of Officer Training School and Air Force Reserve Officer Training Corps Selection Systems**

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Description: Both the Officer Training School (OTS) and the Air Force Reserve Officer Training Corps (AFROTC) use central selection boards to select applicants and to fill program quotas. The selection boards differ somewhat in approach, but the goals are identical; i.e., to select the best qualified personnel from among the applicants. The primary difference in the two selection processes is that AFROTC uses the Weighted Professional Officer Selection System, which was developed through policy capturing. In this system, 11 weighted variables are used to develop a quality index score. For OTS, selection is made by boards, and the selection process does not involve empirically weighted variables. The two selection processes will be compared, and each system will be validated against performance prior to commissioning and at several career points after commissioning.

ROTC Counseling

Utilization: The results will be used to refine and improve the selection of OTS candidates or AFROTC cadets for the professional officer course and subsequent commissioning. This improvement should result in the selection of high quality officer personnel and the reduction of attrition in officer training programs.

Officer Training School Graduation

Title: **Selection for Rated Pilot/Navigator Training**

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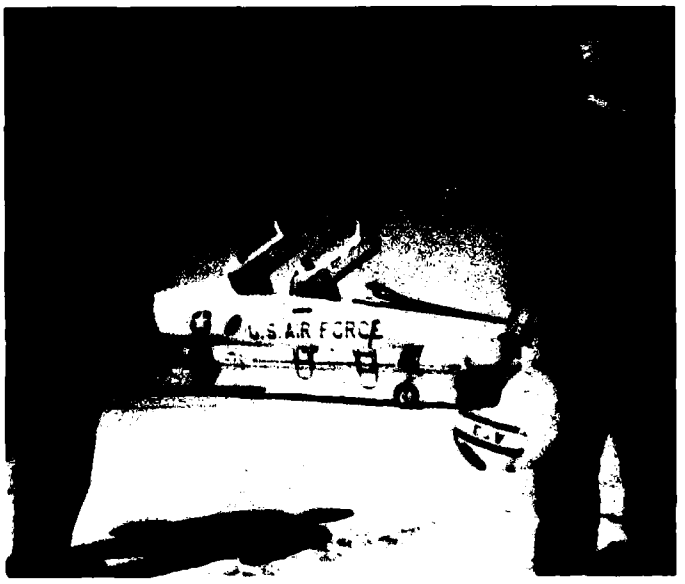
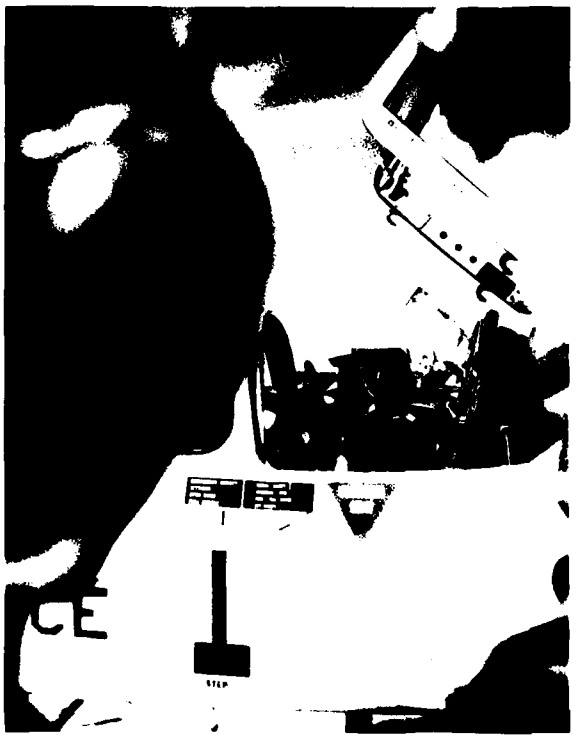
Description: For many years, the Air Force Officer Qualifying Test (AFOQT) has been the primary selection variable for entry of candidates into undergraduate flying training pilot and navigator programs. A program is underway to determine the feasibility of using newly devised tests of psychomotor skills, information processing abilities, and flight skill learning rates to improve pilot selection. One segment of research in this area calls for administration of these tests to large samples of pilot qualified students from Air Force Academy, Reserve Officers Training Corps, and Officer Training School commissioning sources. Another large segment involves an extensive evaluation of the Air Force Flight Screening Program. Preliminary results indicate that the use of the tests of perceptual motor skills could reduce pilot training attrition by 2%. In recent years, the Undergraduate Navigator Training (UNT) program has experienced an unusually high attrition rate. The Navigator-Technical composite for the AFOQT was considerably revised in an effort to ameliorate the problem, but additional research is needed. An experimental Basic Navigator Battery has been developed and administered to 16 UNT classes. The scores from the Navigator Battery and the AFOQT will be compared with performance in Navigator Training and in advanced courses, and with on-the-job performance after 1 year in an operational role. Additionally, research is underway to determine the optimum way to select student pilots for either the fighter/attack/reconnaissance or tanker/transport/bomber basic phase of training within Specialized Undergraduate Pilot Training.

Utilization: The new selection systems will be used by Air Training Command. The selection procedures developed should be useful to Air Training Command in improved selection decisions for pilots and navigators. Attrition from any training school is always very expensive, and this is particularly true for those schools training rated officers. Improvement of the pilot and navigator selection systems should reduce attrition from the Pilot Training and Navigator Training Programs and assist in the identification of superior pilots and navigators in an operational squadron.



Aircrew Selection R&D



Officer Selection R&D

Title: **Development of the Officer Pipeline Management System and Person-Job Match Technology**

AFHRL Contact: Joe Ward
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Description: A coordinated effort has been made to develop a selection and classification model for Officer Training School. A series of senior management level briefings were designed to provide information about the selection policy that was modeled and how it was modeled and to obtain approval to begin implementation, operational test and evaluation, and external validity activities. A new rating scale to be used as part of the selection procedure was field tested and briefed in July 1982.

Utilization: The Air Force Recruiting Service is taking steps to begin using this new procedure for selection and classification of OTS applicants.

Title: **Enhancement of Officer Occupational Survey Technology**

AFHRL Contact: Louis Datko
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Description: The technology developed for Air Force enlisted specialties, Occupational Survey/ Comprehensive Occupational Data Analysis Programs (OS/CODAP) has produced sizable benefits for the Air Force over the years. Empirically derived job indices have guided decision makers in such areas as classification and occupational structure, training requirements, and personnel assignments. Comparable occupational survey technology for officer specialties is still in the formative stages, however. The need exists to improve the measurement technology for officer jobs so that problems in career development, classification, and training, for example, can be broached from a firm empirical knowledge base. Research is presently underway to extend the OS/CODAP technology for enlisted specialties to officer specialties and to develop new measurement techniques when the enlisted technology cannot be directly transferred. Specifically, the objectives are as follows: (a) develop and test job descriptive scales as alternatives to relative time spent, (b) establish the utility of existing task factor scales, (c) develop and test alternate task factor scales where needed, (d) identify appropriate samples for collecting task factor data, and (e) develop CODAP products to display officer data for specific users.

Preliminary analyses of needs assessment data that have been elicited to derive a rank-ordered set of needs for officer occupational data have yielded the following results. The raters assessed all officer occupational data needs as important to the total Air Force mission and demonstrated high levels of agreement in their ratings and rankings. The raters identified the primary applications of officer occupational data to be in the areas of determining training relevance, validating job prerequisites, and assessing officer attitudes regarding such factors as utilization of

talent and training, job interest, and sense of accomplishment.

Utilization: Officer occupational surveys will ultimately be developed using validated task factors and job properties singly or in combination. The developed technology will provide the means for establishing an empirical data base for use by Air Force decision makers regarding utilization of officer personnel. Enhanced officer occupational survey methods can be expected to benefit the Air Force in terms of a more effective classification system, more clearly defined educational requirements, and cost savings in training.

OFFICER OCCUPATION R&D

FORCE ACQUISITION AND DISTRIBUTION SYSTEMS

Title: **Learning Abilities Measurement Program**

AFHRL Contact: Lt Col David L. Payne
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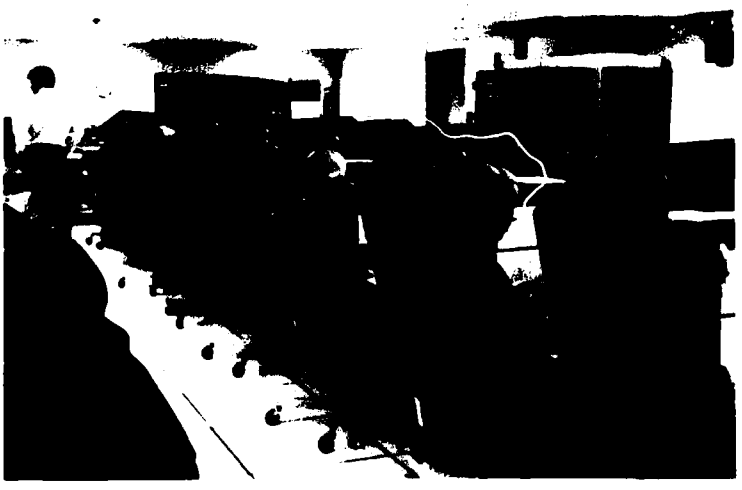
Description: The Learning Abilities Measurement Program is exploring new techniques in the measurement of individual differences in learning and performance capabilities. New technological developments in microcomputer systems and new theoretical developments in cognitive psychology open possibilities of enhancing the state-of-the-art in ability testing. Work in this project is being conducted in parallel efforts under several streams of research by in-house researchers, visiting scientists, and contractors. One stream investigates the possibility that important abilities, now undetected because of inherent limitations of the paper-and-pencil testing medium, might be reliably detected through the use of new computer technology. A second stream investigates the use of parameters from short-term learning curves as predictors of learning speed and ultimate level of performance in more complex, operational instructional settings. Paper-and-pencil tests reliably assess a person's present level of knowledge in a particular domain, but there are no means other than by indirect inference of identifying individuals who are, in fact, fast learners. A related stream of research focuses on the acquisition of certain types of knowledge and skill that eventually become applied effortlessly and that allow individuals to perform multiple tasks in parallel. In this stream, the attempt is made to measure an individual's "present level of automaticity" for some tasks; for other tasks that still require conscious attention, the measure is of an individual's "rate of movement toward automaticity." Some Air Force occupations require that individuals perform many activities simultaneously. It is for these occupations that the automaticity tasks would be expected to have high predictive validity. Another stream of research attempts to measure more purely aptitudes that are being measured by the paper-and-pencil tests. The goal here is to increase the reliability, and consequently, the predictive validity of tests currently in use. More specific descriptions of research now being carried out under each of these streams, along with some early results, are detailed in the following paragraphs.



AFHRL Testing Facility

1. Assessing Mental Automaticity and Rate of Movement Toward Achieving Automaticity: The goal of this 3-year effort, just now getting underway, is to explore the feasibility of assessing individual differences in present level of automaticity and rate of movement toward automaticity in a wide variety of tasks. One important issue to be addressed has to do with the generality of the concept of automaticity across various content domains.

2. Computerized Administration of Cognitive Tests: The availability of reliable, powerful, and relatively inexpensive microcomputers provides an opportunity to accomplish selection and classification testing via microcomputers rather than paper-and-pencil tests. In this effort, a total of 30 cognitive tasks were developed and each was administered to over 300 basic recruits on TERAK microcomputer systems. To facilitate the development and administration process, a set of automatic programming procedures, or "program drivers," along with a test authoring system, was developed. The analyses of these tasks is currently underway and seeks to assess their

reliability and relationship to the Armed Services Vocational Aptitude Battery as well as to other information about the basic recruits.

3. Assessment of the Acquisition of Complex Cognitive Skills: The purpose of this project is to develop and evaluate procedures for the assessment of individual differences in the rate of acquisition and reacquisition of complex cognitive skills. Three goals for the project were (a) to provide cognitive learning tasks that are potentially predictive of success in training and job performance, (b) to determine the similarity of learning processes involved in the acquisition, decay, and reacquisition of different cognitive skills, and (c) to determine the predicted utility of learning rate parameters in selection research. To date, four complex cognitive learning tasks that take 50 minutes each to administer have been developed and evaluated.

4. Cognitive Component Assessment: Individuals as Information Processors: For most skilled Air Force occupations, it is appropriate to view the individual on the job as a general symbol manipulator who interprets incoming information, evaluates it, weighs alternatives, makes decisions, and acts on those decisions. Each of these activities takes time and individuals differ in how quickly and accurately they perform these mental operations. This project attempts to measure directly how quickly and accurately individuals process various kinds of information. The ultimate goal is to build a taxonomy of types of information (content), and the varieties of processing that act on that information and then to describe jobs and training programs in terms of their information processing requirements.

Utilization: Basic research in personnel measurement is needed to rejuvenate a mature technology and to advance the state-of-the-art. Computerized cognitive tests hold promise as supplements to or replacements for conventional ability measures. They may measure some abilities more reliably and in less time than conventional paper-and-pencil tests, and they may measure useful abilities that cannot be measured at all by conventional tests. The primary utilization of the research results will derive from an assessment of the newly developed computerized test measures. This project is expected to establish a test base of possible alternative aptitude measures for use in the development of operational tests for both enlisted and officer personnel.

Researcher Monitoring Testing

AD-A129 552 AIR FORCE HUMAN RESOURCES LABORATORY ANNUAL REPORT - FISCAL YEAR 1982(U) AIR FORCE HUMAN RESOURCES LAB BROOKS AFB TX R M BUESCHER JUN 83 AFHRL-TP-83-15 2/2

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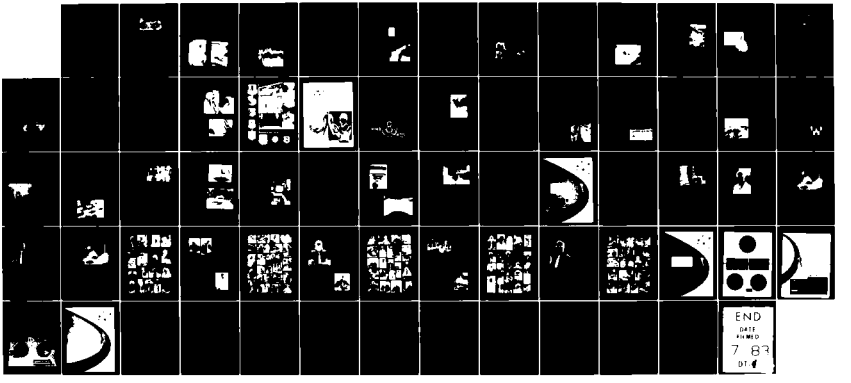
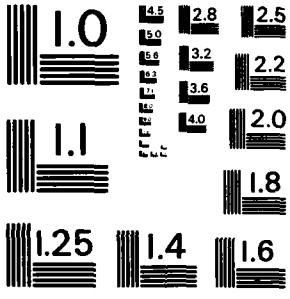
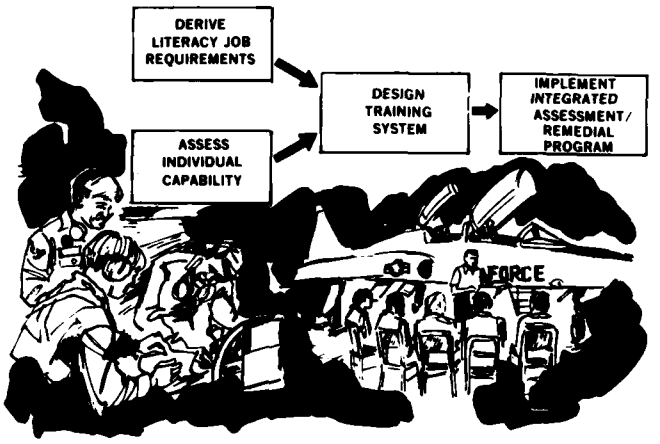




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A



DEVELOPMENT OF A JOB-ORIENTED BASIC SKILLS EDUCATION PROGRAM

Title: **Development of an Integrated, Task-Oriented Basic Skills Assessment and Enhancement System**

AFHRL Contact: Sherrie P. Gott
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Description: The ever-growing technological sophistication of Air Force equipment and systems and the projected decline in the size of future military labor pools provide the basis for this investigation into the basic cognitive skill requirements of Air Force enlisted occupations. The need for this research and development is underscored by unacceptable levels of literacy among recent military enlistees. Plans are being formulated to develop and apply an integrated assessment and enhancement system that will (a) scientifically derive and validate basic skill job requirements, (b) assess concomitant cognitive skills of enlisted personnel, and (c) provide design specifications for training to remediate personnel deficiencies.

Multiple concurrent efforts are contemplated with respect to the three program components: job measurement, personnel measurement, and training design. Air Force occupational survey technology will be used in both data collection and data analysis phases, the initial application being a test of the feasibility of the job inventory (task level) approach to the measurement of basic skill job requirements in a selected group of occupational clusters. For the job measurement phase, both multiple data sources (e.g., job incumbents, supervisors, training instructors, training and job materials, personnel basic skills proficiency data) and data collection methods (e.g., paper-and-pencil survey, interview, materials evaluation, task performance assessment) will be used in various combinations. Additionally, techniques for routinely updating the job requirements data base will be investigated. Personnel measurement milestones will involve test identification and development to validate identified skill requirements and to diagnose individual skill deficiencies. Empirical job requirements and personnel performance data will then be used as the basis for designing training modules to remediate deficiencies and to equip job incumbents with the basic skills needed for job proficiency and career progression.

Utilization: This effort is part of a comprehensive program of research undertaken by the AFHRL to improve classification, assignment, and training systems through empirical determination of enlisted force job requirements. After an advanced development phase, the job-oriented, basic skills remedial training program will be proposed to replace the existing basic skills programs, which are not functionally oriented.

Title: **Perceptual-Motor Ability Measurement**

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Description: Previous research has demonstrated the utility of measures of perceptual-motor abilities for the selection of personnel for pilot and navigator training and for technical training. The interest in these measures has been revived, following the discontinuance of apparatus testing in the 1950s, as computer-based testing techniques and the use of highly reliable solid-state components have become more widespread. These developments have eliminated most of the difficulties inherent in earlier electro-mechanical testing equipment. Testing devices utilizing solid-state electronics have been developed which administer two tests for psychomotor coordination. These devices have been used to collect data from a large sample of individuals slated for pilot training. These individuals are being tracked through training and the relationships between the test scores and training performance determined. Additionally, a large, comprehensive array of new perceptual-motor and cognitive performance tasks has been developed and research is underway to demonstrate its usefulness for pilot and navigator selection. Subjects are being tested prior to their entry in training and their performance throughout training is being collected. Measures derived from this battery which show promise when assessed in a laboratory setting will later be incorporated into field-transportable testing devices for possible use in an operational setting.

Utilization: Perceptual-motor tests may be used by recruiting and assignment agencies and by the Air Training Command for the selection and classification of rated officers. The use of tests of perceptual-motor abilities will result in the reduction of attrition from training and a corresponding reduction in training cost.

Psychomotor Test Device, 1970's Technology

Basic Attribute Test (BAT) Station

FORCE ACQUISITION AND DISTRIBUTION SYSTEMS

Title: **Estimation of Air Force Enlisted Manpower Supply**

AFHRL Contact: John Taylor
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AUTOVON 240-3047

Description: During the past 2 years, econometric research in the Air Force enlisted accession and retention market has resulted in the development of a data file for analyzing the impact of changes in civilian and military economic and policy parameters on the distribution of enlisted personnel by specialty, experience, and aptitude, The data file was also used to econometrically derive the necessary relationships for performing these impact analyses, both Air Force-wide and in a few selected levels of occupational specialty and/or quality groupings.

A 2-year extension to this effort will provide for a detailed analysis of accession and retention within specific Air Force specialties (AFS). A model will be developed to integrate the individual AFS and facilitate forecasting of the effects on total-force accession and retention of various policy and economic variables. Theoretical work on the supply-demand relationship developed earlier in this effort will be expanded to permit examination of individual AFS as well as groups of AFS. After individual or subgroups of AFS have been examined, the integrative model will permit the aggregation of the various AFS categories into a total system for studying such topics as the costs and benefits of retraining, prior-service enlistments, effects of the GI Bill on accession and retention, and effects of retirement policies on the force structure.

An additional research task has been undertaken to make the extensive data bases, which have been developed to support the econometric analysis, available to and usable by a wider segment of the AFHRL research staff and other Air Force agencies. This new contract effort will produce a plan for utilizing the historical data files and will also suggest enhancements to the files and potential data management/access systems.

Utilization: The results of this effort will provide Air Staff offices with quantitative means for justifying various programs to the Office of the Secretary of Defense and to Congress. As an example, it is anticipated that through this effort it will be possible to demonstrate the cost-effectiveness of the selective reenlistment bonus program. Other results should enable Air Force planners to make effective use of fiscal resources to meet accession and retention goals.

Enlisted Manpower

Title: **Enlisted Assignment/Reassignment System**

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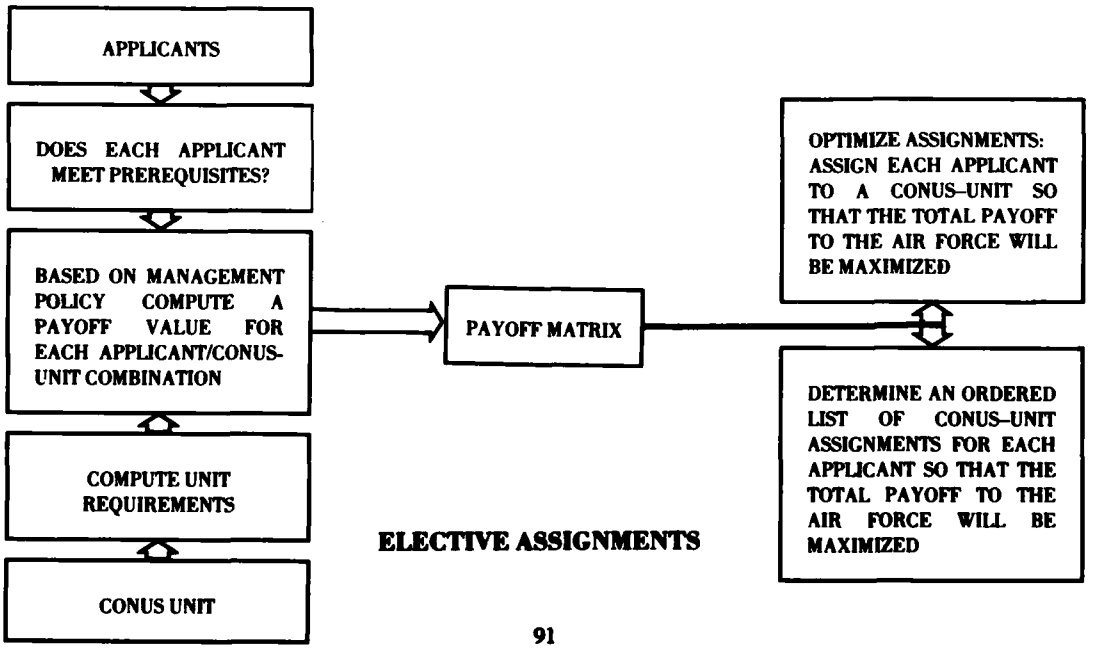
AUTOVON 240-3047

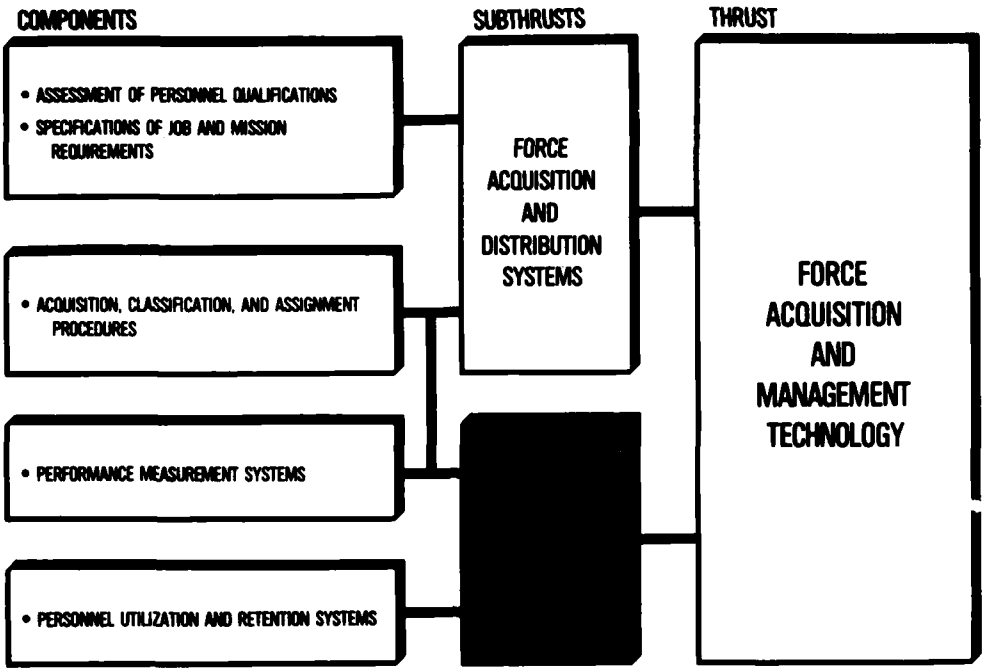
Description: This work supports the geographical assignments function of Air Force personnel management. There is an opportunity to examine this assignments function at its most basic level. The objective of this project is to design two alternative systems for assigning airmen to locations. The first will use policy modeling (e.g., policy specifying) to develop algorithms for modeling the individual payoffs of assigning airmen to locations. The general development sequence will be (a) customer involvement (problem identification), (b) policy payoff algorithm development through a working group, (c) policy testing, and (d) modifications as necessary. The resulting procedure will combine important person and location variables, optimize the payoffs, and produce either an optimal assignment of airmen to locations or an ordered list based on optimality indicators.

The second system is designed to assign airmen to locations using a goal-programming approach. This approach will employ goals set forth by managers to assign personnel. The general development sequence for the goal-programming application will be (a) customer involvement, (b) management identification of goals which can be achieved, (c) testing, and (d) modifications as necessary. Goal programming is a procedure that will minimize the deviations from management goals to achieve an optimal solution within management constraints. This approach can also produce either an optimal assignment or an ordered list. Both systems being developed will use the same type of optimization software. The one using the policy-specifying technology will maximize the sum of the payoff values generated, and the other will minimize the deviation from goals. Planned milestones are prototype development to demonstrate approaches and the feasibility of the approaches, demonstration of goal-programming assignment methodology, identification of optimization software, and policy algorithm development.

Utilization: These two alternative systems will contribute to better assignments of airmen by the Air Force personnel system. The successful development and demonstration of a prototype model has shown the feasibility of the policy modeling approach to the elective (self-initiated) assignments programs. The demonstration of the prototype model has resulted in the desire to develop models of this type for the elective program with the probable application in the future of the same technology to the larger reassignment system.



ELECTIVE ASSIGNMENTS



Title: **Productivity Measurement and Enhancement**

AFHRL Contact: Charles N. Weaver
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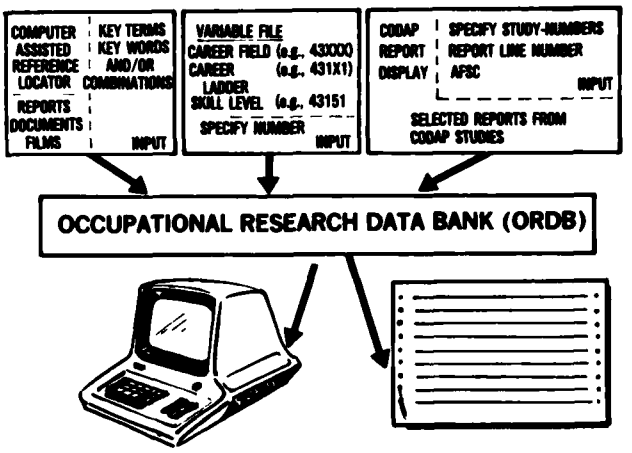
Description: A recent research project has focused on productivity measurement and productivity enhancement. The purposes of research in the first area were (a) to review current and past efforts to define/measure productivity, (b) to classify those measures with respect to practicality, cost-effectiveness, and relevance to the Air Force, (c) to systematize the major classes of factors that have been shown to impact on productivity, (d) to develop a conceptual framework, based on empirical data, that can serve as a guide to future research and evaluation efforts, and (e) to develop a method for generating efficiency and effectiveness measures for the Air Force work center environment.

Productivity Measurement

A field test was conducted to evaluate the methodology of this project and to assess its application to Air Force work centers. The specific objectives of the field test were (a) to determine its acceptability to participants, (b) to determine the extent to which resulting productivity indexes used existing data sources, and (c) to determine the generalizability of resulting indexes across similar organizations. The methodology was applied to 24 organizations, eight each of administration, propulsion, and weather. Results indicated that the methodology was highly acceptable to participants. Moreover, the indexes showed moderate generality across similar organizations (e.g., among administrative units) and, to a large extent, utilized existing data sources. Overall, it appears that this methodology offers a means for generating "hard" productivity criteria for research and/or management purposes. The results and findings from the field test for the productivity measurement study will be documented in a technical report during fiscal year 1983.

Utilization: Development and assessment of the method for generating productivity criteria across Air Force work units provide researchers and managers with a useful tool for designing and evaluating changes in organizational factors related to productivity. Additionally, the identification of and communication with various agencies involved with productivity research have fostered a positive interaction among those agencies. Technologies for implementing feedback and goal-setting techniques will provide first-line management with a capability for enhancing productivity and job satisfaction that otherwise would not be available.

Benefits: Results from the productivity criterion generation study will be used to plan and conduct a comprehensive study of Air Force productivity, to increase the generalizability of results from studies on productivity, to improve management of Air Force resources, and to increase the readiness and effectiveness of Air Force personnel.



Title: **Development of an Air Force Occupational Research Data Bank**

AFHRL Contact: Hendrick W. Ruck
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AUTOVON 240-3551

Description: Efforts to establish an Air Force Occupational Research Data Bank have resulted in the development of an on-line rapid access retrieval system for different kinds of occupational data. This retrieval system includes summary-descriptive variables about Air Force occupations, occupational survey data for the enlisted occupations, and a research report index system by occupations. The retrieval system provides the capacity to reference research materials through a cross-catalogued key word search and select, display, and print by specialty and subgroup variables related to occupational descriptors, prerequisites, and enlisted personnel characteristics. It also allows the user to extract various Comprehensive Occupational Data Analysis Programs reports. At present, these prototype systems within the Occupational Research Data Base are operational. Work has been directed towards the inclusion of medical, legal, and safety data. In addition, longitudinal analysis and cross-occupation analysis capabilities are being built into the system.

FORCE MANAGEMENT SYSTEMS

Utilization: The Occupational Research Data Bank has been designed to support the research thrusts of the AFHRL. The large volume of occupational data contained in the retrieval system provides a centralized location for researchers to obtain quick-response answers for questions regarding the characteristics of specialties, such as mean test scores, ethnic mix, and geographical distribution. At present, such questions may take weeks to answer. Cross-comparisons of specialties with respect to their characteristics are feasible and should lead to more effective selection of occupations for special studies. Personnel and training data from calendar years 1978 through 1980 are presently available. Medical, safety, and legal data from calendar years 1980 and 1981 are available also.

Benefits: The Occupational Research Data Bank provides rapid access to a centralized source of occupational data. Limited studies with short suspense dates could be accomplished without the need to extract data from longitudinal studies and trend analysis can be performed on a real-time basis to provide a dynamic representation of occupational data.

Title: **Retraining and Transferability of Skills**

AFHRL Contact: Mary J. Skinner
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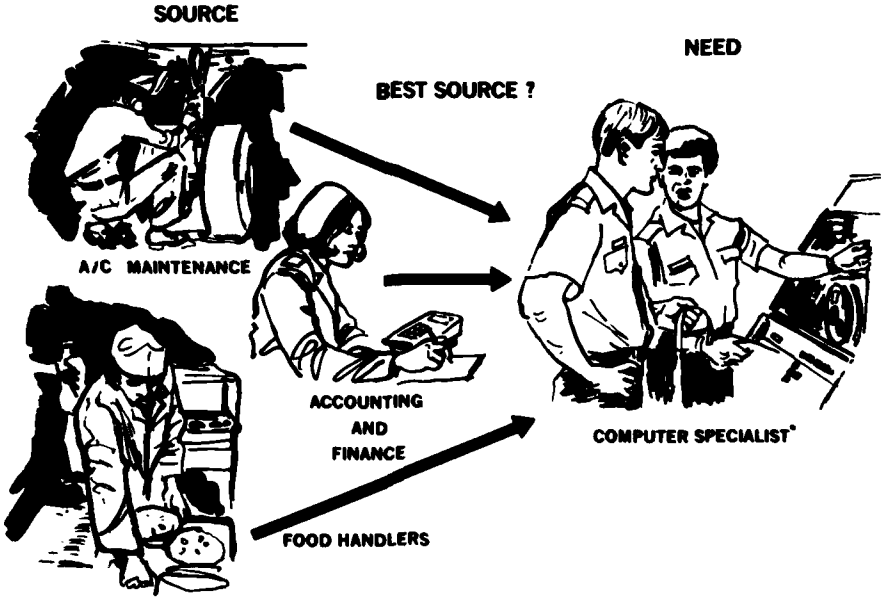
AUTOVON 240-3222

Description: Current research includes identification of the types of retraining actions that are operating smoothly and those that are generating adjustment problems. Retrained airmen and their supervisors have been surveyed to evaluate the job performance, satisfaction, and attitudes of retrainees. Preliminary analyses of the survey data have been completed, and the interim results indicated that retrained airmen had typically made a smooth and successful transition between military occupations. Further analyses will evaluate retraining success for various categories of retrainees. Another ongoing effort has the objective of assessing the skill upgrading, career progression, and reenlistment rates of retrainees through comparisons with Air Force averages. Historical data analyzed to date



RETRAINING GUIDELINES FOR SELECTION AND CLASSIFICATION

indicated that the time required to upgrade between skill levels for retrainees was less than or equal to overall Air Force averages. Retention at 8, 12, and 16 years was comparable for the two groups. Analyses of promotion progress are ongoing.

Two final studies, which focused on the performance of retrainees in technical training, have been completed. The results indicated that, overall, retrainees do better than non-retrainees in technical school. Performance of retrainees was found to depend on aptitude level, time in service, and type of previous experience. Results of the second study of technical school performance supported the current policy that permits 10 points of the job entry aptitude requirement to be waived for retrainees. A final pair of studies focuses on the performance of retrainees in technical training. The first study compares the academic performance and attrition levels of retrainees to those of new recruits with equivalent aptitudes. The effects on retrainees' performance of years of military service, career or non-career status, and type of background experience prior to changing specialties is also being evaluated.

Utilization: Managers of the Airman Retraining Program are sponsoring and utilizing the current research that provides an empirical basis for evaluating policy decisions.

Benefits: Improved retrainee selection and assignment procedures can be expected to stimulate participation in the program, favorably impact reenlistment rates, and increase productivity and satisfaction of airmen in second specialties. Assignments that optimize skills transfer will result in dollar savings through lowered attrition rates, as well as reductions in training time required for retrained personnel to achieve proficiency in their new occupations.

Title: **Non-Appropriated Fund Supervisory Appraisal of Employee Performance**

AFHRL Contact: Douglas K. Cowan
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Brooks AFB TX 78235
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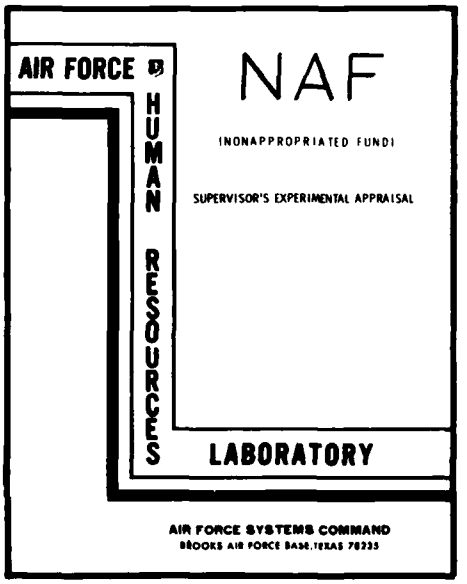
AUTOVON 240-3570

Description: A modified non-appropriated fund (NAF) supervisory appraisal form will be developed to evaluate NAF employees throughout the Air Force. The primary purpose of the modification is to align the current form with the requirements of the 1978 Uniform Guidelines for Employee Selection. Revised appraisal elements will be developed though field input, subject matter specialist selection, and judgment analysis (policy capturing) of a promotion panel.

Utilization: The revised form, developed to meet the requisites of the Equal Employment Opportunity Act and Uniform Guidelines for Employee Selection, will minimize the threat of litigation and provide objective ratings that can be used to promote, remove, counsel, and reward NAF employees.



Experimental Appraisal Form

FORCE MANAGEMENT SYSTEMS

Title: **Effective Utilization of Personnel in Mechanical Career Fields**

AFHRL Contact: Suzanne Lipscomb
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Description: During the past decade, the number of women in the Air Force has increased from approximately 12,000 to more than 60,000. To provide Air Force management with information relevant to the optimal utilization of women in nontraditional military roles, a study of the Aircraft Maintenance Career Field is being accomplished with the objective to evaluate the on-the-job utilization patterns of males and females and to identify gender differences in task assignment, in job changes over time, and in job expectations, experiences, and attitudes. The analysis of the job expectations, experiences, and attitude data indicates that some significant differences do exist between males and females in their reasons for entering the Air Force and the Aircraft Maintenance career field, in their previous mechanical experience, and in their plans for civilian work. Differences were also indicated in the area of expectations as to the amount of strength required on the job, initial supervisor confidence, and desire to leave the Air Force. However, differences were not found to be gender specific in other areas of expectations, experiences, and attitudes. Overall, satisfaction with the Air Force and their jobs, current supervisory confidence, job difficulties and job changes were not found to be different for males and females. An analysis of on-the-job utilization patterns indicated that there are differences in the way males and females are utilized across the career field. Within utilization areas few differences were indicated in the work performed by males and females. Also, there is no apparent meaningful difference in the "learning difficulty" of the jobs performed by males and females within the utilization areas or over the career field as a whole. Preliminary results of this study have been briefed and further analyses are in progress.

Utilization: Information generated from these studies has been used in making management decisions regarding the utilization of women in the Air Force. Decisions made utilizing this research have allowed an expansion of the role of women in the Air Force resulting in an increase in selection ratios for certain career fields and the optimal utilization of the personnel resources available to the Air Force.

Female Airman in Non-Traditional Role

Title: **Evaluation of Individual Performance in Mechanical Specialties**

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Description: With a limited labor supply, the optimal utilization of all Air Force personnel becomes increasingly important. The ability to assess objectively and accurately an individual's level of performance on the job is critical to many areas of human resource management. Specifically, in order to evaluate the validity and efficiency of systems for personnel selection, assignment, training and utilization, effective measures of on-the-job performance are necessary. The mechanical career area is a vital part of the Air Force; included are such diverse specialties as telephone equipment installation, aircraft maintenance, masonry, and carpentry. All these jobs require a high degree of mechanical competence, and entrance requirements to mechanical specialties include a minimum level of mechanical aptitude as measured by the Armed Services Vocational Aptitude Battery. To ensure that these key mechanical positions are staffed with the best people, continual refinements are made to the personnel system. A methodology to objectively assess individual on-the-job performance within these specialties could provide empirical feedback to optimize the refinements and provide a means for assessing the impact of policy, equipment, and training changes. A method to provide objective feedback on actual job performance in the mechanical career areas would thus help improve the capability of the Air Force in operating its highly mechanized force. To meet these needs, an effort is underway to develop an integrated performance assessment methodology applicable to all mechanical career fields. The methodology will consist of a general framework of instruments and techniques and a set of clear-cut decision rules that can be applied to the content of each job. The prototype system, if successful, would be applicable to a full range of functional specialties. A contract to accomplish this effort has been awarded, and the development of methodology is underway.

Mechanical Career Field Assessment

Utilization: The performance assessment system developed by this effort will be used to assess individual performance levels in order to evaluate the validity and efficiency of systems for personnel selection, assignment, training, and utilization.

FORCE MANAGEMENT SYSTEMS

Title: **Study of Alternative Weighting Systems for Enlisted Promotion**

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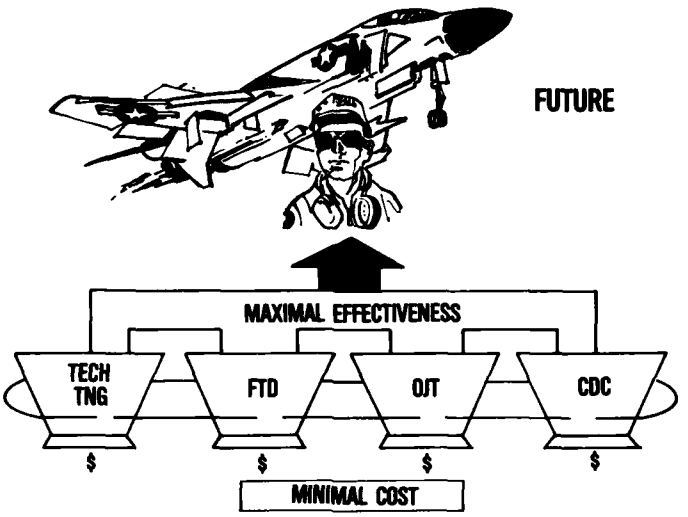
Description: The purpose of this effort is to support a request from the Directorate of Personnel Plans at Headquarters USAF (HQ USAF/MPX). The request calls for the development of alternative weighting procedures for the Airman Performance Reports (APRs) factor in the Weighted Airman Promotion System (WAPS) that will bring the WAPS formula into

Enlisted Promotion Systems

better alignment with the current Air Force management position regarding recent performance and promotion selection. Specifically, the alternative weighting systems requested should minimize promotion selection of airmen with recent, low APRs. The requirement for this WAPS modification was identified by the Air Force personnel community during the fiscal year 1982 airman promotion cycles. At that time, it was determined that the WAPS formula, which defines relative rather than absolute quality, did not always eliminate poor APR performers and consequently selected several hundred airmen for promotion who had recent, low APR ratings.

HQ USAF/MPX suggested that alternative weighting systems be developed without the use of experimental promotion boards or policy-capturing procedures that have been used previously for the development of WAPS in 1968 and for subsequent revalidations in 1972 and 1977. Consequently, the approach for this study will consist of devising several alternative APR-weighting systems using numerical methods or mathematical processes which have potential for achieving the desired management objectives. Then, the relative merit of each alternative system will be assessed empirically in terms of several criteria. Preliminary empirical analyses will be performed on samples of airmen eligible for promotion to grades E-5, E-6, and E-7 in several critical non-critical shortage Air Force Specialties. The alternative systems devised will be evaluated by comparing their hypothetical promotion selectees with selectees identified by the current WAPS. The selectees will be compared in terms of recent APR performance and average performance on other WAPS factors. Additionally, the degree of similarity of the alternative weighting systems to the current WAPS will be determined by examining (a) Pearson correlations of promotion scores, (b) percentage of agreement ("overlap") among selectees identified by the alternatives and the present system, and (c) promotion selection rates for minorities and women. The most effective alternatives identified during the preliminary empirical analyses will be applied to the promotion eligibles in every specialty within three WAPS promotion cycles so that the impact of the alternative weighting systems on each speciality will be known. The most viable alternative weighting systems will be reported to HQ USAF/MPX.

Utilization: Information developed in this study will be used by HQ USAF/MPX to remedy the problem of WAPS promotion selection of poor performers as well as bring the WAPS formula into better alignment with the current Air Force management position regarding performance and promotion selection.



TRAINING DECISIONS SYSTEM

Title: **Research and Development of a Training Decisions System**

AFHRL Contact: Hendrick W. Ruck
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Description: The objective of this effort is to develop a user-oriented, interactive, computer-based system for training resource allocation and training assignment decisions at the worker-task or task cluster level. The effort will involve the exploratory development of four subsystems: (a) a task characteristics/task clustering subsystem to address the what and where of training, (b) a field utilization subsystem to address the consequences of training decisions in terms of personnel assignment strategies and mission accomplishment, (c) a resource/cost/capacity subsystem to assess the resource and capacity constraints and cost tradeoffs of training decisions, and (d) an integration subsystem to interface the other subsystems into a user-oriented, interactive, computer-based, training decisions system.

Utilization: This effort will produce a training decisions system that will provide readily available, validated information to the Air Staff and user commands, especially the Air Training Command, on costs and consequences of training decision alternatives under different constraints, costs, and personnel utilization patterns. The following benefits are anticipated from the implementation of such a system: (a) enhanced mission readiness through optimizing the mesh of technical training resources and overall operational demands, (b) increased training efficiency through optimizing the sequence and settings in which training occurs, (c) improved personnel utilization through development of methods for analyzing functional job patterns in relation to optimized training sequences, (d) increased cost effectiveness of training through the formulation of training decisions based on explicit cost and resource consequences, and (e) reduction of excessive operational training commitments through more accurate estimation and analysis of unit capacity to train while meeting on-going mission demands. This effort will be supportive of, but will not duplicate, a parallel effort by the Logistics and Technical Training Division of AFHRL to develop specifications for an integrated training system for on-the-job training.

Title: **Development of a Manpower Projection of Skill Requirements Model**

AFHRL Contact: Larry W. Wolf
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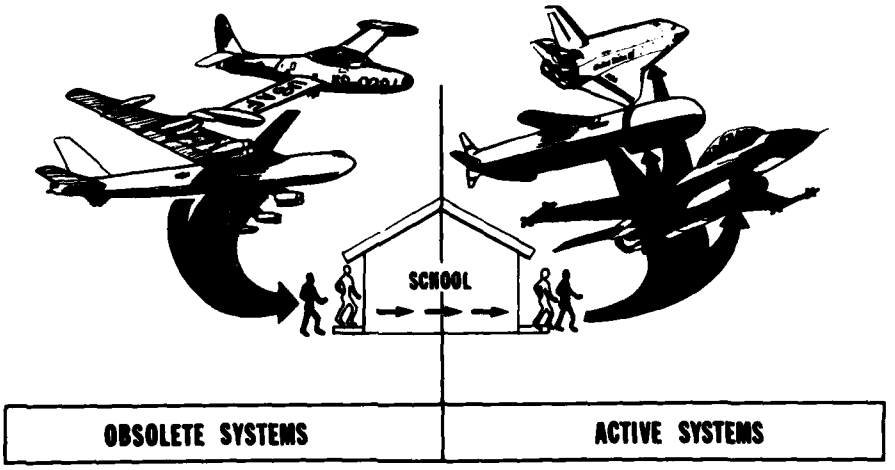
Description: This model is designed to project skill requirements corresponding to alternative compositions of program elements, accounting for technological changes currently being implemented. The methodology is as follows: (a) categorize selected Air Force Specialties according to growth, shrinkage, stable or mixed patterns since 1977, (b) determine the timeliness with which changes in the 5-Year Defense Plan are reflected in the RCS: HAF(MPC)-7102 (manpower) file (7102 file) and analyze how changes in and uncertainties about, the implementation timing of major force programs or changes thereto affect the timeliness, completeness, and accuracy of the 7102 file, (c) determine the impact of program element changes on Air Force Specialty distribution patterns, and assess how discrepancies between predicted and actual program levels vary as the prediction period shrinks, (d) describe the needs for and uses of skill projection data throughout the Air Force manpower, personnel, and training system, (e) analyze commonalities between skill projection and other AF requirements analysis tools, such as functional and program estimating equations, (f) review skill projection techniques used by other military, government, and civilian organizations, (g) synthesize and evaluate alternative methods of skill projection for effectiveness in the AF management structure, (h) build and test a prototypal model, and refine it into a full-scale model, and (i) implement the full-scale model.

Utilization: This research will implement a new skill projection model to assist in the manpower and personnel planning and budgeting process. This model will enable manpower management to estimate more accurately and in a more timely manner the skill requirements for various program element combinations that are mandated. The new model will greatly aid in ensuring that manpower with the appropriate skills is available in quantities necessary for mission accomplishment.



MANPOWER SKILL REQUIREMENTS

Title: **Process Models of Personnel Turnover**

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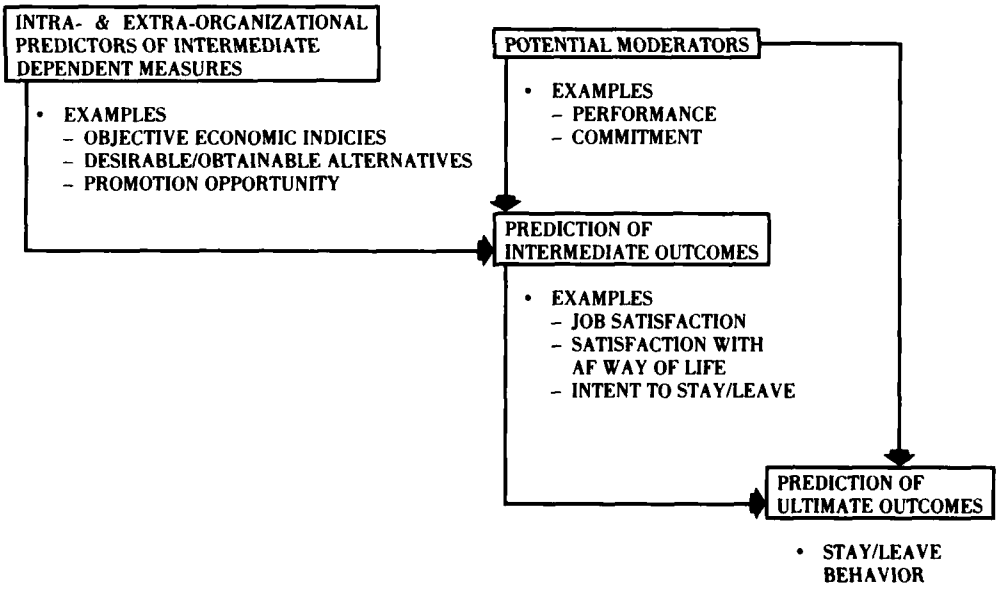
Description: This R&D effort is in support of the Air Force function of sustaining its personnel resources. Specific objectives are to identify factors influencing turnover and retention in the enlisted force and to assess changes in these determinants over time.

This research involves a longitudinal assessment of determinants of turnover over time from process-model and open-systems perspectives. Emphasis will be on determination of post-enlistment factors that can be measured via survey methodology. In order to provide a multimethod assessment of the determinants of turnover decisions, both paper-and-pencil and telephone survey instrumentation will be used. This investigation is based on the assumptions that factors influencing turnover and retention change over the career cycle and that intraorganizational as well as extraorganizationl factors influence such decisions. Initial paper-and-pencil survey instrumentation is currently under development.

Utilization: Identification of factors influencing turnover and retention decisions of Air Force enlisted personnel, and their change over time, will provide a basis for making informed management decisions to help retain valued Air Force members.



HYBRID MODEL OF TURNOVER

FORCE MANAGEMENT SYSTEMS

Title: **Performance Relevant Situational Constraints**

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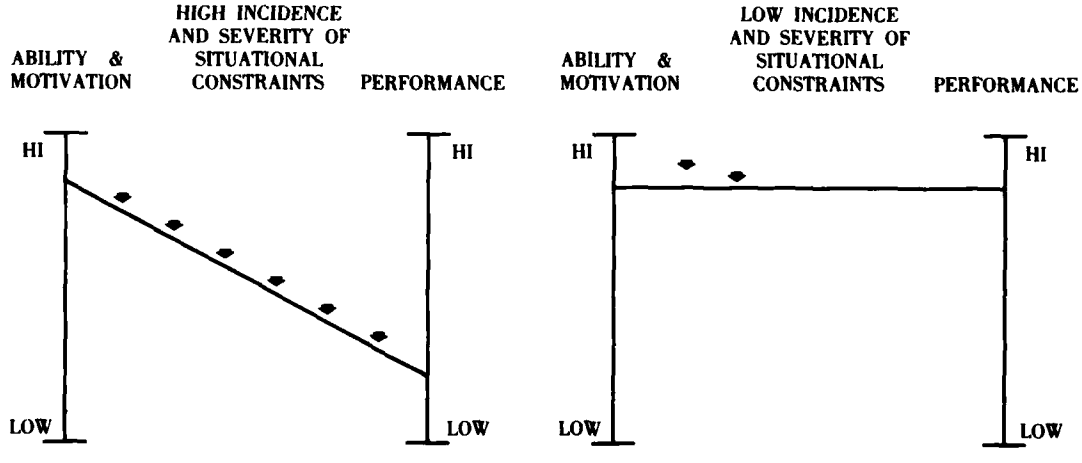
Description: This effort is part of a comprehensive AFHRL program to identify factors that influence productivity. The purpose of this research is to identify situational constraints in operational work environments that are perceived by job incumbents to inhibit their productivity, and to develop, refine, and validate a questionnaire instrument that can be used to identify such factors in diverse settings. The study involves four phases in which different samples of first-term enlisted personnel will be selected for survey administration. The first phase has been completed, the second phase is nearing completion, and preparation is underway for the third and fourth phases.

During the first phase, a questionnaire eliciting open-ended responses was administered to a sample of 330 first-term airmen at 12 Air Force bases, and the results were content analyzed. On the basis of this analysis, 14 constraint dimensions were identified, which were used to develope an objective questionnaire. This questionnaire was administered to a second sample of approximately 1,500 first-term enlisted personnel at 25 Air Force bases throughout the world. Responses to this questionnaire will be factor analyzed, and the instrument will be refined. Also, the extent to which situational constraints are present in a variety of Air Force jobs will be identified.

During the third phase, the focus will be on a more limited set of incumbents in each of 6 Air Force specialties and the instrument will be validated against performance, satisfaction, and turnover intent criteria. In the fourth phase, using a sample of incumbents in a single specialty, hypotheses concerning the moderator effects of situational constraints will be examined.

Utilization: Identification of situational constraints to productivity, as well as development, validation, and refinement of a questionnaire to measure such constraints, will provide Air Force researchers and managers with important information and a tool to deal with productivity problems. Knowledge of factors that impede productivity will provide managers in a variety of operational work settings with the information they need to make organizational and workgroup-specific changes to enhance productivity.



PERFORMANCE UNDER VARYING CONDITIONS

Title: **Personnel Factors Related to Attrition and Retention**

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Reenlistment Oath

Description: This R&D effort is in support of the Air Force function of sustaining its personnel resources. Specific objectives are as follows: (a) to identify personnel and occupational factors related to attrition and retention in the enlisted force, (b) to develop reliable and valid techniques for collecting such information, and (c) to design practical and efficient methods for incorporating results of this R&D into current selection, classification, and assignment programs.

The approach to the study involves a conceptual analysis of the personnel retention problem. A bibliography of military and non-military personnel turnover literature has been distributed, and a technical paper addressing the issues of definition, classification, and measurement of termination and retention criteria has been published. Files are being developed for use in a number of analyses in this research program. Retention studies will include the tracking of historical trends in attrition and retention, longitudinal studies of cohort groups from time of entry to time of loss, cohort analysis of loss rates, investigation of occupational differences in continuation rates over time, and analysis of alternative attrition/retention prediction systems to include evaluation of their impact on personnel acquisition.

Reenlistment Counseling

Utilization: Identification of personnel factors related to attrition and retention allow better forecasting of force strength and attenuation of factors influencing personnel turnover.

THE RESEARCH AND DEVELOPMENT PROGRAMS OF THE AIR FORCE HUMAN RESOURCES LABORATORY SUPPORT OPERATIONAL COMMANDS AIR FORCE-WIDE.

AIR FORCE COMMUNICATIONS COMMAND

TACTICAL AIR COMMAND

AIR FORCE LOGISTICS COMMAND

AIR TRAINING COMMAND

MILITARY AIRLIFT COMMAND

Electronic Security Command

TECHNICAL SUPPORT

TECHNICAL SUPPORT

Title: **Technical Support of Comprehensive Occupational Data Analysis Programs**

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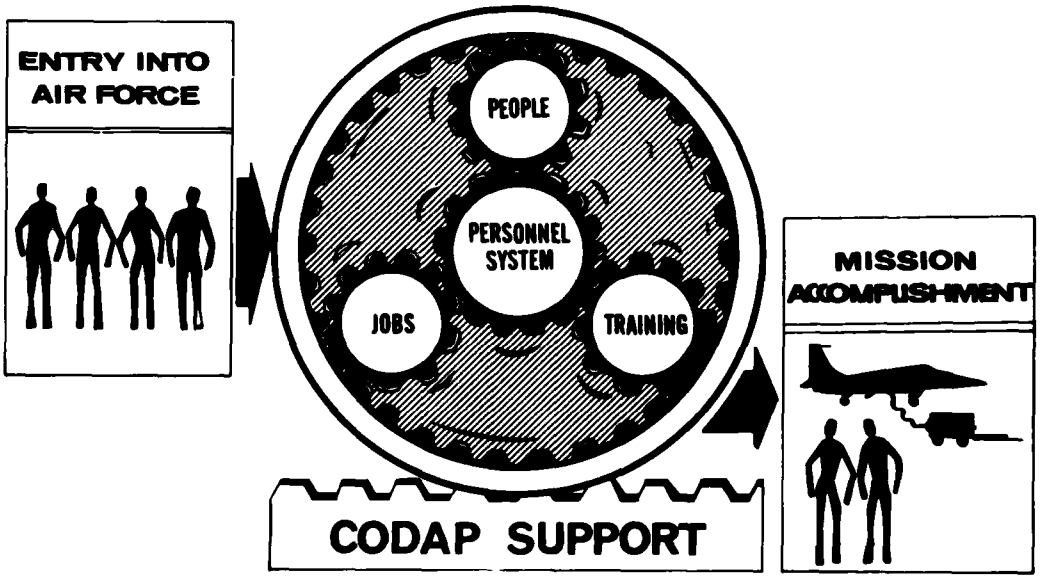
Description: The Comprehensive Occupational Data Analysis Programs (CODAP) system was developed to provide an efficient and effective method of identifying and classifying jobs in a rapidly changing Air Force environment. The Technical Services Division of AFHRL develops, maintains, documents and provides training in the use of the CODAP system by data processing personnel at the Laboratory and at the USAF Occupational Measurement Center. The basic input to the system is information provided by a large number of supervisors and job incumbents in the occupational area being studied. Because the data are collected at the worker-task level, CODAP provides a base of information that can be viewed in many ways and then used to address new and unanticipated management questions whenever they arise. The purpose of the technical programming support is to improve the operational efficiency of the programs and to develop interactive terminal routines that relieve most of the less critical activities associated with setting up computer runs.

Utilization: In addition to the operational uses of CODAP in developing and validating the content of training programs, it is being used to address questions about the requirements of jobs that will be integrated with the initial personnel selection process and eventually with the person-job - match model. Although CODAP was developed by the Air Force, all branches of the Department of Defense, as well as the British, Canadian, and Australian military forces, have incorporated this system into their operational programs. Many state and county governments are also beginning to use CODAP to validate their traditional testing and selection procedures and, at the same time, to develop performance evaluation criteria. Educational institutions are using CODAP to modify the curricula of their vocational education programs.



Title: **General Purpose Program Development**

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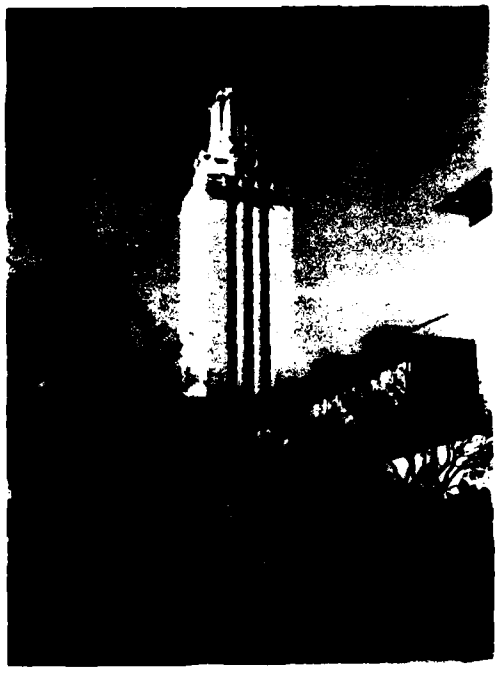
Description: The Technical Services Division of AFHRL develops, maintains, documents, and provides training in the use of general purpose computer software. This software includes the broad categories of (a) language translators such as pre-compilers and interpreters, (b) utility programs such as sort/merge and report writers, (c) general purpose applications programs such as correlation/regression analysis and multi-dimensioned frequency distributions, (d) and subroutine libraries containing common computing algorithms. The Technical Services Division is responsible for more than 460 general purpose and statistical analysis programs and over 2,300 pages of users guides to those programs. Benefits to AFHRL derived from the development of general purpose programs include (a) a reduction in the number of unique occurrences of a computing algorithm and thus a decrease in the possibility for error, (b) an increase in individual programmer productivity by reducing the number of special purpose programs to be written and audited, (c) the standardization of products, which reduces analysis time by the researcher; and (d) a concentration of program maintenance and enhancement activities into a group specialized in the production of efficient computer software.

Utilization: General purpose software supports virtually all Univac 1100/81 data processing activities related to the AFHRL research program as well as the computational support to other agencies, such as the Air Force Manpower and Personnel Center and the USAF Occupational Measurement Center. One such program, PRISM, was designed as a high level utility programming language specifically for the development of interactive programs with complete control of all Univac 1100/81 facilities and file types. PRISM was used to create several new software products such as (a) the PDP tape conversion system used to collect data from the Laboratory's Experimental Test Facility,(b) the documentation retrieval system used to maintain and query a data base containing 2,000 pages of automated reference manuals, (c) and the general purpose file layout system used to maintain on-line record descriptions for all master files and applications study files.



AFROTC Detachment

Title: **Follow-up on Air Force Reserve Officer Training Corps Graduates with Scores of 20 and Below on the Officer Quality Composite of the Air Force Officer Qualifying Test**

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Description: In the fall of 1971, Air Force Reserve Officer Training Corps (AFROTC) was authorized to begin enrolling applicants for the advanced program without regard to the individual's score on the Officer Quality Composite (OQC) test. Prior to this approval, cadets were required to score 25 or higher on the OQC for admission to the program. After approval, applicants were selected by use of the multiple factor selection system (MFSS). This

system involves a whole person concept in which all available information about the applicant is considered along with the OQC score, which though still a factor, is no longer a single eliminating element. Comparisons of 320 AFROTC graduates commissioned in FY74 under the MFSS and a comparative sample of 960 non-MFSS AFROTC graduates commissioned in FY74 have been made each fiscal year from 1976 through 1981 to study the long-term similarities/differences in undergraduate pilot training, undergraduate navigator training, technical training, officer effectiveness report ratings, and continuation in the Air Force. In order to provide data through the time period that allows the completion of 6-year active duty service commitments, an analysis of the data collected and updated through FY81 is being provided.

Utilization: The results of this long-term effort will be used by AFROTC to assess the impact of MFSS graduates on the active duty force in terms of success/non-success in pilot, navigator, and technical training courses and continuation in the Air Force.

Title: **File Item Data Organizer**

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Description: The File Item Data Organizer (FIDO) data base containing selected data elements from Air Force Manual (AFM) 300-4, Volume 3, Data Elements System, was designed, developed, documented, and is being kept current by the Technical Services Division. FIDO evolved from the need of R&D efforts involving present and longitudinal sample selection where codes contained in the AFHRL unique data base had to be identified and interpreted by research scientists. A major FIDO application is the preparation of file edits. In such an application, a microfiche report is prepared which contains both the frequency and English language meaning for each code value within each data element of a file. Use of "on the shelf" file edits can effectively direct the research planner's attention to potential problem areas in construction of working samples from master files. FIDO also contains an automated inquiry/retrieval system vital for the establishment of data bases for personnel research projects and probe analysis to determine the feasibility of proposed major R&D efforts involving data bases.

FIDO is on-line on the AFHRL Univac 1100/81 computer system. It consists of 711 Air Force and Department of Defense defined data elements used in automated Air Force personnel data systems; examples are security classification, grade, Air Force specialty code, and major academic field. The update procedures now in use are to be improved so they will provide more accurate and timely data. Also, procedures are to be developed to get this information directly from the data base developed by the Air Force Data Systems Design Center. The update procedures are now supplied to AFHRL monthly by magnetic tape. In early FY83, it is anticipated that AFHRL will be on the Advanced Research Projects Agency Network that will allow direct access to the AFM 300-4 files at the Air Force Data Systems Design Center. This will reduce the delay time which AFHRL has experienced in the past in receiving the updated files. The File Item Data Organizer Two (FIDO2) has been created. This system keeps a history of the Data Use Identifier found in AFM 300-4 and gives the user access to it from its first entry into AFM 300-4.

Utilization: FIDO directly supports virtually all facets of personnel and manpower R&D conducted by AFHRL. Many R&D efforts involve longitudinal studies of specific samples cutting across many different data files and code values over varied time periods. Automated availability of Air Force and DoD defined data elements, as well as other nonstandard data elements, with their data values and meanings across time when combined with heavy usage by programmers/analysts, represents a sizable savings in work hours. These hours would otherwise be spent in researching hundreds of manuals and/or microfiche by hand in order to find the needed code properly identified for a given historical time period.

As FIDO is implemented, scientists may, on retrieval, specify all code values in effect dating back to the establishment of a given data element or may specify inclusive dates and get only those codes in effect during the interval in question.

The data can be displayed on a remote interactive terminal or a hard copy may be requested showing title, data name, definition/explanation, code values, effective dates, and explanation of code values. The Laboratory staff estimates the system is used 3,000 times per year. The times accessed represent the number of files for which FIDO definitions are obtained. On a large file, such as the Uniform Officer Record, distributions can be obtained for 1,954 data elements. A conservative estimate is that an average of 50 data elements are researched each time the FIDO system is accessed, for a total of 150,000 data elements per year.

Title: **Officer Effectiveness Report System**

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Description: Officers are normally given Officer Effectiveness Report (OER) evaluations once a year. The evaluations are used as (a) a tool in determining the individuals best qualified for promotion, (b) a tool for making assignments, (c) a counseling device and (d) a general personnel management tool. In addition, these reports aid in the monitoring of the rating trends. The automated OER report system uses the OER records, which have been transcribed to magnetic tape to produce summary reports on a quarterly and yearly basis for grades of lieutenant through colonel separately. The reports aid assignment managers, career monitors, personnel managers and OER monitors.

Utilization: The OER detail and summary reports have allowed Air Force managers, policy makers, major commanders and separate operating agencies to track the progress of the OER and to identify trends, problems and areas needing emphasis. In addition, the selection board secretariat uses the statistics in their pre-promotion board preparations. The data have been used in numerous briefings presented throughout the Air Force at all levels. On several occasions, information extracted from the reports has been briefed and discussed with Corona Conference audiences comprised of the Chief of Staff and major commanders. The system contains and reports information not available in any other automated personnel data system. The Air Force is in a better position to monitor the OER system as a result of the summary reports developed by AFHRL.

Title: **Human Resources Research Data Base**

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Description: A series of data bases containing information on personnel and training systems has been developed and updated with FY82 data. Software has been implemented to process, organize, and display selected information from a single data base and to consolidate information on a common subgroup from two or more data bases. Procedures are established to receive automated personnel and training data generated in standard and command-unique data systems separately on officers and enlisted personnel which reflect personal characteristics at time of entry, performance outcomes during flying or technical training, career status at periodic

Personnel Data File

PERSONNEL RESEARCH DATA BASES

- 3055 TAPE REELS:
  - 2627 REELS (DATA FILES)
  - 428 REELS (INTERIM PROCESSING)
- 847 DATA FILES:

% OF DATA FILES	RECORDS PER FILE
54	100,000
36	100,000 – 499,000
10	500,000 – 4.7 MILLION

intervals and information related to reenlistment or separation. Special files will be created to meet long-term study requirements and longitudinal files will be constructed to facilitate studies in career development. File management and information retrieval procedures have been developed and are maintained under Microform System 4B-73.

The data bases include records of all active duty Air Force enlisted and officer personnel at 6-month intervals, and on Air Force Reserve and Air National Guard personnel. Also included are records of graduates from basic military training, technical training, and flying training programs and from the Officer Training School and Reserve Officers Training Corps commissioning programs. Other files reflect separations and losses from active duty. Special purpose longitudinal files derived from these data bases significantly reduce data processing requirements in many personnel and training R&D studies.

Utilization: The data base represents a low-cost means of acquiring and maintaining information used in the development and validation of personnel selection and classification instruments, development of assignment procedures, derivation and revalidation of promotion systems and special purpose analyses to determine the long range impact of specific personnel and training policies. The availability of these data makes it possible to carry out studies on numerous aspects of the personnel and training systems that would otherwise be infeasible.

Title: **Historical Data Base of Enlisted Personnel by Cohort Year Group**

AFHRL Contact: Charles A. Greenway
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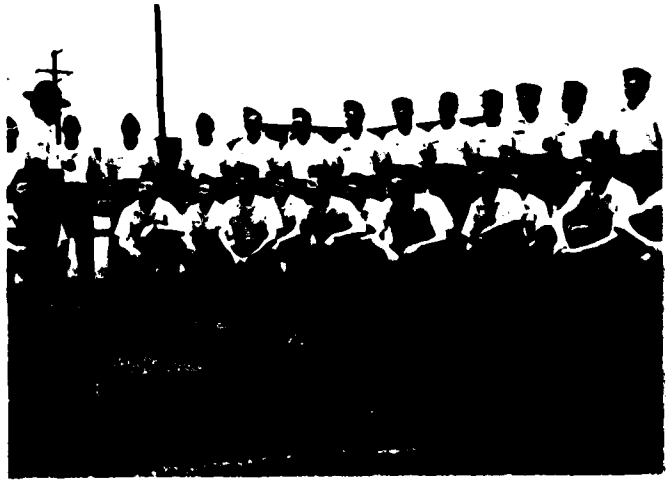
Description: The cohort data base supports loss/reenlistment/extension analyses requirements/trends by fiscal year of accession. This data base has been developed covering accessions and associated loss/reenlistment/extension transactions for a 10-year period and is current through the first half of FY82. Statistical tables, using this data base are prepared semiannually. They reflect the (a) percentage of total lost (within each type of loss category), (b) percentage of loss from accessed population at the beginning of a year to cover a 10-year period, (c) cumulative percentage of loss, (d) percentage of those lost in Basic Military Training (BMT) by type of loss category, (e) percentage of those lost subsequent to BMT by type of loss category, (f) total percentage of extending population, (g) percentage of beginning population who have extended and are on extension, (h) percentage reenlisting, (i) percentage reenlisting with/without bonus, (j)



Enlisted Personnel R&D Support

percengage reenlisting with less/more than 90 days to expiration of term of service, and (k) percentage of losses eligible/not eligible to reenlist. Statistical summary tables to provide quick reference to the number of individuals accessed in each fiscal year also show the (a) number lost, (b) loss rate, (c) retention rate, (d) continuation rate, (e) number reenlisted, and (f) reenlistment rate. These counts and percentages are reported for each of the 10 fiscal years covered by the report.

Utilization: These reports are used to track enlisted retention by cohort year groups, relate enlisted retention/reenlistment losses to personnel program objectives, and analyze the retention/ reenlistment/losses of cohort year groups by various demographic attributes, such as sex, race, academic education level, Armed Forces Qualifying Test group category, term of enlistment, age at accession, number of dependents, and marital status. These reports are used by personnel systems managers at Headquarters United States Air Force, the Air Force Manpower and Personnel Center, and the Office of the Secretary of Defense.

Title: **Air Force Personnel Survey Program**

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Description: The Technical Services Division of AFHRL provides optical scanning and computational support on the Univac 1100/81 computer system for Air Force personnel surveys approved by the Research and Measurement Division of the Air Force Manpower and Personnel Center. The data reduction and analyses of approximately 30 surveys per year are accomplished by using general purpose computer programs developed by the Technical Services Division. Pre-survey work includes sample selection and the preparation of self-adhering address labels. Also, on-site training is provided for the Air Force Manpower and Personnel Center programmers who are responsible for processing survey data.

Utilization: Upon completion of each survey analysis, the raw data files are retained for use in Laboratory R&D programs. The survey products are used by Air Force managers at all levels. The Technical Services Division processed a follow-up analysis of a special Department of Defense Engineer Survey conducted by the Joint Logistics Commanders of the Air Force, Army, and Navy.

Title: **Technical Training Graduation/Elimination Rates**

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Description: Analyses of technical training graduation or elimination rates (a) provide personnel managers data to track elimination rates of enlisted personnel from basic resident technical training courses, (b) provide information on the characteristics of successful and unsuccessful students in basic resident technical training courses with regard to mental ability, aptitude, educational level, race and sex, and (c) appraise the effects of the 4-year, 4-year guaranteed, 6-year, and 6-year guaranteed enlistment options on success rates in basic resident technical training courses. Summary reports are prepared quarterly for Air Force enlisted personnel who terminate technical training in each quarter of the fiscal year. Frequency counts and percentages are reported for each reason of termination of training, i.e., graduation, academic elimination, medical elimination. Frequency counts and percentages are also reported for average scores of the following Armed Services Vocational Aptitude Battery (ASVAB) variables: Mechanical, Administrative, General, and Electronics tests and on the Armed Forces Qualification Test for each basic resident technical training course and selected special courses. All of these frequency counts and percentages are reported for each course by race, sex, race/sex combined, 4-year or 6-year enlistments, academic education level, and mental category.

Utilization: The reports are being used to focus on total attrition from technical training courses with special emphasis on the high-cost electronics courses that require a minimum score of 80 for admission. The reports are used also for briefings

at higher echelons and for updating trends tables. These reports are also used by Headquarters United States Air Force, the Air Force Manpower and Personnel Center, Headquarters Air Training Command, and the Air Force Recruiting Service.

Title: **Support to Other AFHRL Divisions**

AFHRL Contact: Jimmy D. Souter
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Description: The Technical Services Division of AFHRL performs large-scale statistical services and data-processing support for Laboratory R&D programs. These services are performed in response to approved work requests initiated by all AFHRL divisions. In addition to the processing of work requests, this Division reviews that processing to ensure complete and accurate results.

Utilization: During FY82, more than 300 work requests were processed, and at any one time, approximately 350 work requests were open for processing. The following examples of R&D efforts illustrate the diversity of the work performed.

AFHRL Experimental Test Facility

Experimental Test Facility Support: The Laboratory's experimental test facility (ETF) located at Lackland AFB is used to study the basic parameters of learning ability. Experimental tests constructed by in-house researchers are administered to test subjects from the Lackland Military Training Center on 30 individual TERAK 8510 computers. The results from testing sessions are consolidated onto magnetic tape using a PDP-11/34 computer. The Technical Services Division created a tape conversion, index and retrieval system for collecting these large volumes of data. This software is especially designed for the fast and efficient throughput necessary to detect data problems and provide immediate feedback to the researchers in the event of data transfer problems. The immediate resolution of problems is critical to the success of this effort because the experimental tests are administered on interactive computers and cannot be reproduced. In six separate test battery collection projects, 4,146,839 ETF data records were collected from 3,349 test subjects.

Armed Services Vocational Aptitude Battery (ASVAB): The Augmentation of ASVAB 5/6/7 Correction File study was processed for the AFHRL Manpower and Personnel Division. ASVAB forms 5, 6 and 7 contained normative problems beginning with their inception in 1976 resulting from erroneous percentile conversion tables. The objective of this study was to identify all airmen accessions tested by use of one of these forms and make corrections using original raw scores and correct conversion tables for estimating procedures developed by the Manpower and Personnel Division for cases where no raw scores were available. A total of 317,088 records were corrected.

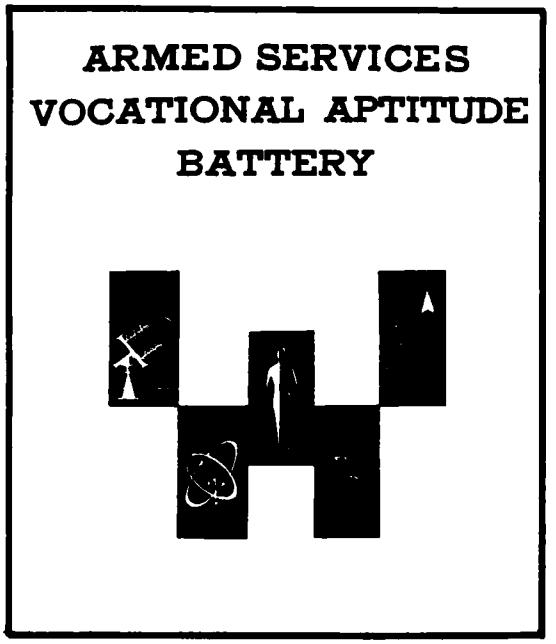
Subsequent analysis requests were accomplished for the Manpower and Personnel Division involving the corrected ASVAB 5, 6 and 7 scores. A study, Career Tracking of ASVAB 5/6/7 Cases, was initiated because there is a major concern within the Department of Defense associated with evaluation of job performance (vice training) as a basis for validation of the Armed Forces Qualifying Test and with the establishment of enlistment standards relevant to "quality" performance in the enlisted force. As an interim measure, this study compared test scores against available criteria such as training completion, Airman Performance Reports, loss

from the force by cause, skill upgrade, and promotion history. In accomplishing the study, a sizable effort was required in combining data from a large number of historical data bases before generating the requested statistical analyses. The Validation of ASVAB 5, 6 and 7 (Race X Sex) study was accomplished as the result of a request by the Office of the Secretary of Defense (OSD) that an additional validation study be performed on the ASVAB forms 5, 6 and 7. Of particular interest to the OSD were possible differences denoted by race and sex. This study was a validation of selector aptitude index (AI) scores as predictors of success in the various Air Force technical training courses by race and sex. Descriptive statistics and regression analysis (including weights, equations, intercepts and standard errors of estimates) were required on over 700 samples. Samples were developed by subdividing cases by various combinations of race, sex and technical training courses. This analysis was accomplished in a minimum amount of time as a result of the extreme time constraints placed on AFHRL. ASVAB scores were the major data elements used in the generation of numerous descriptive reports necessary for summarizing the characteristics of Air Force enlisted accessions such as in the study Air Force Accessions Quality for 1980-1981.

Additional ASVAB analysis was required on the Profile of American Youth data file furnished by the National Opinion Research Center (NORC) of the University of Chicago. This file is unique in that each of the 11,914 cases is weighted to represent a portion of the approximately 33 million youths 14 to 22 years of age as of 1 January 1979. The generation of descriptive statistics and reports was necessary for review of this file, including the use of weights for certain analyses and comparisons of outcomes with NORC generated outcomes.

Occupational Research Data Bank: Three data files were generated for the Occupational Research Data Bank (ORDB) statistical display system. These files consisted of information extracted from Uniform Airman Record (UAR) and Airman Gains and Losses (AGL) files. These data are extracted annually, summarized by duty Air Force Specialty Code (AFSC), career ladder, and career field for first-term airmen, second-term airmen, career airmen, and total and annual input (calendar year). The 1979 ORDB data file was based on 512,617 UAR records of airmen who were active during 1979 and consisted of about 3 million statistical data records. The 1980 data file was based on 532,578 active 1980 UAR records and consists of approximately 3.3 million statistical data records. The 1980 and 1981 Pipeline Management System (PMS) variables were added to the ORDB. This adds statistics of Pipeline trainees by training AFSC. The PMS files contained 245,531 records for 1980 of which 116,745 were used for ORDB-PMS. The 1981 ORDB-PMS files used 118,750 of the 292,343 PMS records. The ORDB-PMS files annually add 30 new tables to the ORDB.

AFOQT Consolidated Data Base: A data base, Consolidated AFOQT Data (LMN) with Common Metric Scores was generated for the AFHRL Manpower and Personnel Division. The purposes of the numerous analysis requests accomplished were to rescore AFOQT data to verify the accuracy of reported percentile and raw scores, to equate test scores using common test items, and to generate common metric scores. The analysis



ASVAB Support

files were subsequently used in norming and evaluating the implementation of form 0. The data base includes forms L, M, and N test data from Reserve Officer Training Corps test sites (January 1972 to September 1982) and non-ROTC test sites (January 1975 to March 1982).

Strength and Endurance: The strength and endurance R&D effort is designed to assess the physical job requirements for all AFSCs. A master tape file containing 1,552 strength and endurance data files was developed to consolidate the results of 194 contractor studies covering 313 AFSCs (including shreds). For each AFSC, the data include the raw survey responses, supervisors' strength and endurance ratings, and the statistical results computed from these files. Interactive software was developed to facilitate rapid query of the master file content and retrieval of selected data files for additional R&D efforts.

Strength and Stamina R&D Support

Transfer of Training Data Base for B-52 and KC-135 Students: The Technical Services Division produced a benchmark file for Operations Training Division of grade ratings for each crew position by sortie by event (task) of crewmembers of B-52 and KC-135 aircraft. Computer reports were developed to systematically reduce the data to statistical information which was meaningful and manageable by the research scientist. Reports of this type will allow the investigator to detect the effect of changes, such as the reduction in flying hours or use of simulators in course content or method of presentation. The computer technology developed for the analysis of these data may be generalized to other R&D efforts which include repeated events.

Title: **Support to Outside Agencies**

AFHRL Contact: Jimmy D. Souter
AFHRL/TSO
Brooks AFB TX 78235
Commercial (512) 536-3928
AUTOVON 240-3928

Description: The Technical Services Division of AFHRL provides statistical services and data processing support to approved agencies outside AFHRL. Work requests are initiated on behalf of the outside customers and then processed in the same manner as those for other AFHRL divisions.

Utilization: During Fiscal Year 1982, more than 20 studies were performed for outside agencies. The following items illustrate the range of these activities.

Transfer of Technology: The Comprehensive Occupational Data Analysis Programs (CODAP) system was shared with other agencies approved by the Air Force Systems Command. These agencies were Florida State University, San Antonio City Public Service Board, Canadian Department of Defence, and the Australian Department of Defence. CODAP will be used to perform job analysis within their own and affiliated agencies.

Surveys and Testing: Optical scanning and data processing support for personnel surveys and special testing were performed in support of the Electronic Security Command (ESC) COMFY Olympics program used to select and reorganize the top three performers in each of 16 career fields. This is the third year that the Laboratory has provided this support to ESC, which uses the competitive program to upgrade and maintain job skills in each of the 16 career fields.

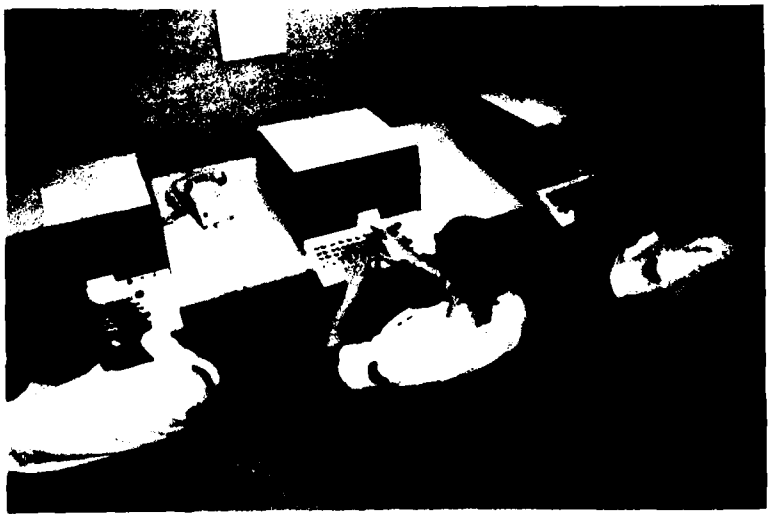
AFOQT Centralized Scoring Systems: Using a system of computer programs developed by the Technical Services Division, the Air Force Manpower and Personnel Center (AFMPC) personnel located with the Laboratory at Brooks AFB processed 23,128 answer forms of Air Force Officer Qualifying Tests (AFOQT) administered during FY81. Individual test results are distributed to each test site. Microfiche reports from the quarterly master file updates are distributed to AFMPC and to the Recruiting

Service. The total master file currently containing 27,982 records is maintained in the Technical Services Division for R&D purposes. The centralized system standardizes and guarantees the accuracy of AFOQT scoring throughout the country.

Reading Skills: The Reading Skills and Requirements (Dec 81 UAR) study was performed for the Air Force Extension Course Institute (ECI). Reading grade level for all enlisted personnel of skill level 5 and below who were on active duty as of December 1980 was computed using a conversion technique developed by AFHRL. ECI uses the reading skills and requirements reports in conducting its text quality control program. This report is essential when interpreting the relationship between reading grade level of ECI course materials and the reading skills and requirements of the student body.

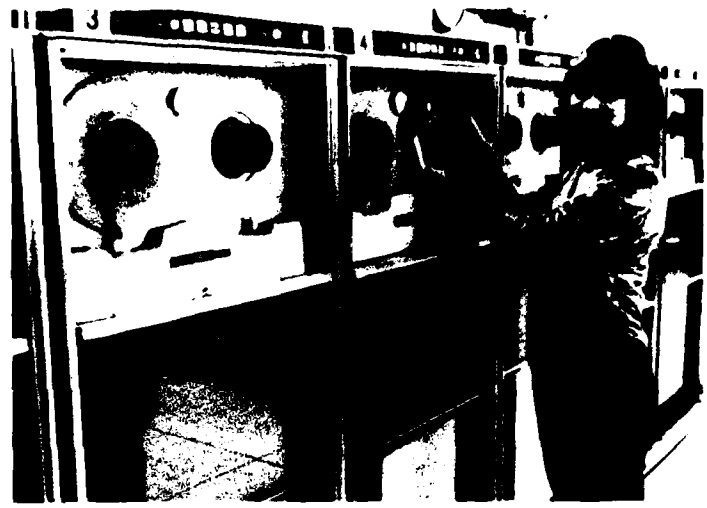
Air Force Engineer Requirement Study: This study was accomplished for the Air Force Management Engineering Agency (AFMEA) as the result of a critical shortage of Air Force engineers. Its purposes were to determine the expertise needed in the existing Air Force engineering career fields, to help develop accession level requirements, to adjust manpower authorizations where necessary, to document advanced academic degree requirements, and to help highlight possible problems that might require further follow-up studies. The analysis consisted of identifying persons in an Air Force engineering career field, generating address labels to be used for mailing out survey instruments, and providing data reduction and summary analysis for the survey instruments completed and returned. This analysis was required on a preliminary random sample of an initial validation of the survey instrument and subsequently accomplished on a worldwide, total, engineering career field sample. An active role in planning and coordinating the make-up and format of summary tables with AFMEA personnel was required due to the complexity and necessity to evaluate almost every possible combination of survey responses.

Top Block Officer Effectiveness Report (OER) Analysis: AFHRL was asked to perform analysis of OERs for AFMPC to provide information for use in the annual report prepared by Equal Opportunity Treatment. The initial question was related to whether there were differences in proportion of personnel receiving top block OER ratings as a function of demographic characteristics of the ratee. The request was expanded to investigate whether there are differences in the proportion of personnel receiving top block OERs as a function of the interaction of the characteristics of the rater and ratee. A computerized analysis procedure was developed to identify subgroups of cases, based on the ratee and rater characteristics, where the proportion of cases receiving top block ratings for a particular subgroup varied from that of the proportion of cases receiving top block ratings for all personnel in that particular grade. The analysis procedure reduced by 85% the total number of subgroups considered for review.



Data Base Maintenance

The Technical Services Division of AFHRL maintains a general purpose Univac 1100 computer system to support research and development programs. Programs include extensive personnel research at AFHRL, medical research at the School of Aerospace Medicine, both headquartered at Brooks AFB, and occupational measurement by the Occupational Measurement Center at Randolph AFB.



Technical Services R&D Support

The Univac 1100 system includes a 3,072-square-foot computer room, and a 2,068-square-foot tape library which houses between 15,000 and 20,000 active tape files. The tape library is a historical data base of Air Force personnel files dating back to the mid-1940s. It contains 37 unique data files, the largest of which is the Airmen Reenlistment and Loss file containing approximately four million records dating from 1955 to 1979.

The computer hardware itself is designed to accept data tapes written in all standard formats. This allows the laboratory to accept data collected by other organizations on their computer systems. It also permits AFHRL to prepare tapes in formats acceptable to other organizations. The 1100 system supports all major programming languages to include FORTRAN, COBOL, and System 2000 which have the heaviest usages. Over 300 people are authorized use of the U1100 through a variety of access routes. Means of access include dial-up telephone lines, dedicated telephone lines (these service Luke and Williams AFBs, Randolph AFB, as well as AFHRL contractors and the School of Aerospace Medicine at Brooks AFB) and directly connected terminals (32 at AFHRL).

In addition to the central computing facility at Brooks AFB, AFHRL has computer resources at Williams AFB, Lowry AFB, and Wright-Patterson AFB. The Automated Data Processing Equipment (ADPE) at Williams AFB consists of nine Systems Engineering Laboratory (SEL) 32/75 computers, three SEL 8600 computers, one SEL 7200 computer, a Univac 400 terminal system consisting of two CRT terminals and a printer, a Univac 700 remote batch terminal, and a Univac 200 terminal and printer. The ADPE at Williams is used to support the Advanced Simulator for Pilot Training, which in turn supports the primary mission of AFHRL Operations Training Division.

A Digital Equipment Corporation (DEC) PDP 11/20, at Lowry AFB, currently supports software and instructional material development for maintenance training simulation utilizing microprocessors. The system is interfaced to the CYBER 73-16 and the PLATO IV Systems to provide graphic hard copy capability for either system.

Located at Wright-Patterson AFB is a DEC PDP 11/45 System which supports a research and development project for ground operations training. The objectives are to reduce training time and to improve performance of weapons directors in missile and space command and control systems. The project will utilize a special purpose, high resolution, color roster scan three-dimensional graphics display system.

LABORATORY OPERATIONS CENTER

The Laboratory Operations Center (LOC) is the focal point for collecting and displaying data used in the management of the AFHRL technical program. Using the Generalized Data Base Management System (System 2000), the LOC has established a Management Information System reflecting status and resources data for work units in the Laboratory's research and technology program. The LOC is implementing a plan for inputting data into the data base from the data source using some menu driven and conversational programs on the Univac system using any data terminal. AFHRL personnel can retrieve data and reports using System 2000 and the LOC data base. The LOC can provide various types of color output such as textural, pie charts, bar charts, and line graphs suitable for viewgraph and 35mm projection. In addition to the operational requirements, the LOC is developing software which will enable the Laboratory to update MASIS and JOCAS directly from the data base.

Audio teleconferencing was introduced to the headquarters and remote divisions in May 1981 to demonstrate the overall capability. Various audio teleconferencing equipment is being tried in order to determine the type of system that best fulfills the AFHRL requirements. A large screen projection system was installed in April 1981, primarily to project color graphics. Current capabilities allow projecting video images from standard television, video disk, and video tape. This system will be used to project color graphic displays in near real time using a minicomputer to produce the graphic illustrations using the System 2000 data base. It will become the foundation for a future management teleconferencing system at AFHRL and will ultimately support data, graphics, voice, and slow-scan or freeze-frame television images. Remote divisions will be similarly equipped and thus provide the capability to conduct full-scale teleconferences between two or more locations.

Podium Demonstration of Projected Information

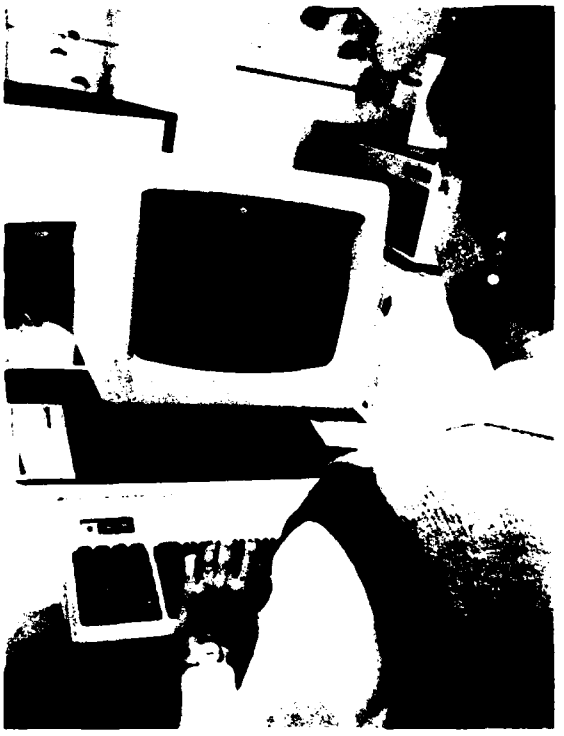
Audio Teleconference in Progress

EXECUTIVE SUPPORT

The Executive Support Branch develops and implements policies, procedures, and standards relating to administration management and practices, military and civilian personnel and manpower actions, and materiel actions. The office provides staff guidance, assistance, and surveillance over other echelons in areas of functional responsibility for the Laboratory Commander. The office staff evaluates administration, personnel, and materiel procedures in other functional areas within the Laboratory and operates the following programs: manpower and organization; forms, publications and reports management; document security; military and civilian personnel administration (including training programs); and organizational supply. Further, the Executive Support Branch is the principal focal point for host-tenant support agreements for the Laboratory and off-base divisions; represents the Laboratory in dealings with other agencies and higher headquarters in all areas of functional responsibilities; and serves as focal point for Inspector General visits and reports.

TECHNICAL EDITING

The Technical Editing Office serves as the focal point for publishing the results of research and development projects. Technical editing, copy editing, and final composition of reports, journal articles, professional papers, brochures, and other documents are accomplished in this office. Guidance is provided to authors and contract monitors to ensure that technical reports comply with government regulations and professional standards. Further, the office staff composes the camera-ready final copy of reports, tests, survey forms, questionnaires, and brochures; maintains liaison with the Public Affairs Office to obtain clearance of technical reports for public release; coordinates printing requirements; and distributes technical reports, special reports, technical papers, and TRACEs (a 1,000-word summary of a technical report).



SCIENTIFIC AND TECHNICAL INFORMATION

The Scientific and Technical Information (STINFO) Office plans and directs the STINFO program, including the Technical Library, to meet the information needs of scientific and technical personnel in managing, monitoring, and conducting research and development. STINFO manages the AFHRL technical publications program, plans and directs the recording of the corporate history, and directs the AFHRL contract data management program. STINFO also serves as the AFHRL foreign disclosure policy office and determines releasability of military information to foreign nationals. The Office maintains close liaison with foreign technology personnel to ensure that foreign research results are available to Laboratory personnel. Further, the Office serves as the focal point for small business and potential contractor programs, patents/inventions/ copyrights, overseas travel, security and policy review, and other related programs.

MANAGEMENT AND SCIENTIFIC INFORMATION SYSTEM

The Management and Scientific Information System (MASIS) is designed by and for research and development program managers in the Air Force Systems Command. The system integrates financial, technical program, and procurement status data into a single data base. Even though all the information systems at the Department of Defense level are still being designed to satisfy the needs of a single functional area, the integration of the laboratory information into a single data base permits maximum use of the data with a minimum amount of input.

Work unit data in MASIS is recorded and retained at the funding action level. For in-house work, the funding action is initiated for the annual estimate of resources. Estimates are updated to actual amounts at the close of each fiscal year from data extracted from the Job Order Cost Accounting System. Funding action for a specific contract or grant is linked to the basic contract or grant record. The basic contract and all follow-on contracts or grants that are a part of the same work effort are mechanically linked together.

The MASIS programmed subsystems are designed for flexibility. The computer programs, rather than being a collection of independent programs that must each be altered when changes are made to the system, are instead a highly integrated system of programmed subsystems that provide the flexibility and responsiveness required of a management information system.

Today, MASIS represents the most comprehensive common system link among all Air Force Systems Command laboratories.

JOB ORDER COST ACCOUNTING SYSTEM

The Job Order Cost Accounting System (JOCAS) consists of more than 80 interactive computer programs used by the Air Force Systems Command for the mechanized accounting of all its resources. All funds and labor are channelled into this system by the base finance units and the laboratories. AFHRL receives over 40 JOCAS reports monthly detailing the resources expended by current month, as well as by year-to-date accumulations.

The JOCAS reports provide resources information to assist managers in optimizing their use of manpower and funds and also in planning for future requirements. Each work unit is identified by a unique job order number and all resources directly supporting a particular work unit are charged to that unique number. One of the primary uses of JOCAS is to identify and track all reimbursement earnings to assure that the reimbursement programs are earned fully, that the proper organization is billed for these earnings, and that these earnings are credited to the unit which earned them.

Various JOCAS reports are analyzed to detect trends in the use/expenditure of AFHRL manpower and funds. Studies are conducted to identify AFHRL direct and indirect labor trends for total laboratory manning, as well as for scientific and engineering personnel and technicians. Similarly, studies identify the funds expenditures in various categories, such as customer, technical planning objective, direct, indirect, and systems. These studies show historical trends over several years and provide valuable management information for optimizing the use AFHRL resources.

LIBRARY FACILITIES

AFHRL Technical Library

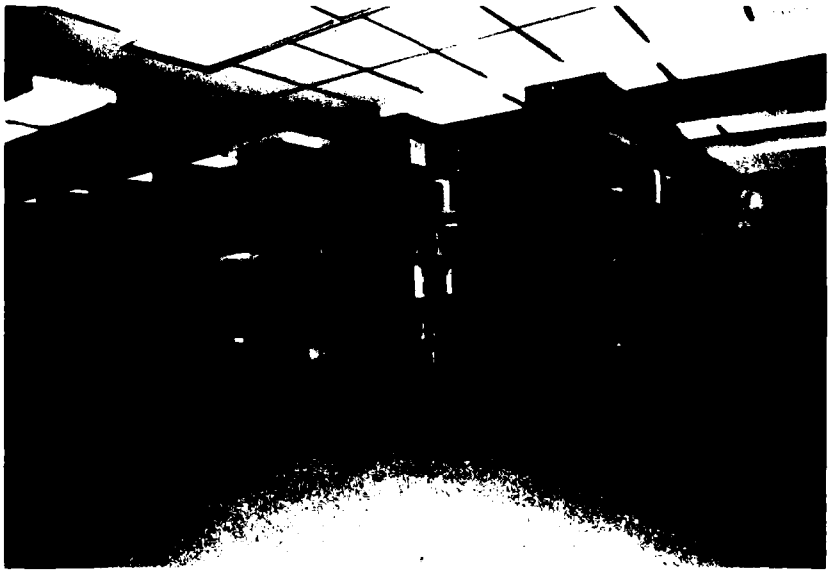
The services provided by the AFHRL Library include the acquisition of books, journals, and other library materials. These services are provided for the headquarters staff offices and the divisions on Brooks AFB, as well as for divisions and offices located in other geographical areas.

The Library has online access to the Information Central System at Wright-Patterson AFB; DIALOG Information Services, Inc. at Palo Alto, California; and the Defense Technical Information Center's Defense RDT&E Online System at Alexandria, Virginia. A contract was concluded with AMIGOS Bibliographic Council, Inc., Dallas, Texas, for accessing a national library network. During the fiscal year, the Library staff accomplished 107 online literature searches.

The Library continued its policy of not binding journals available on 16mm microfilm and of converting backfiles to microfilm. There are now 764 microfilm cartridges in the collection and one cartridge microfilm reader/printer.

The Library participates in two consortia--the San Antonio Area Online Users Group and the Health Oriented Libraries of San Antonio (HOLSA)--and has applied for membership in the Council of Research and Academic Libraries of San Antonio (CORAL). The journal holdings of this Library are included in the HOLSA union list of serials. Membership in CORAL can result in the inclusion of the Library holdings in the CORAL union list of periodicals and the CORAL union list of monographs.

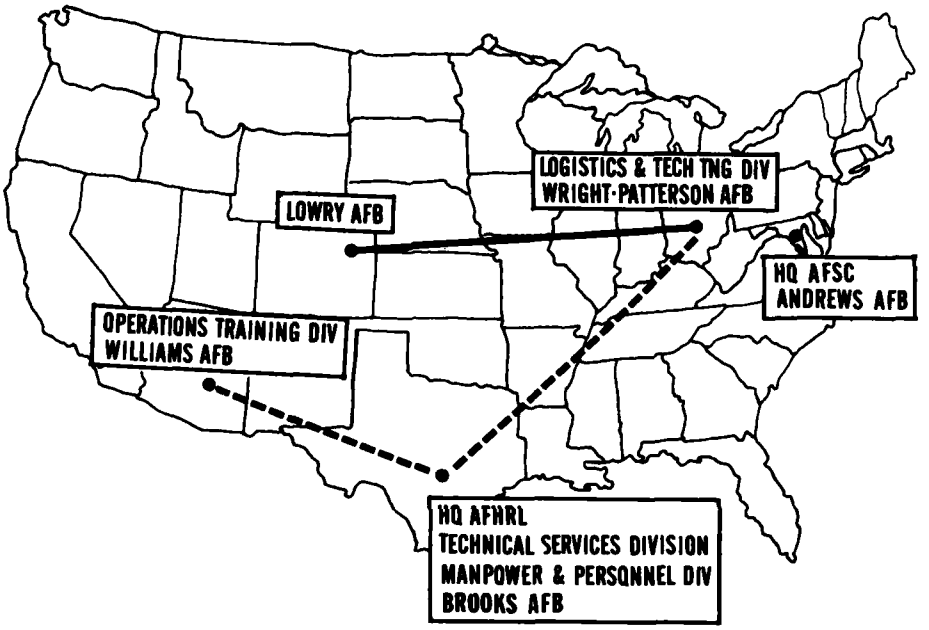
Library holdings at the end of the fiscal year were 13,807 books and bound volumes of journals, 11,631 technical reports (2,680 of these are on microfiche), and 459 journal subscriptions. The office collection at the Logistics and Technical Training Division, Wright-Patterson AFB, consists of 307 books. The Technical Training Branch, Lowry AFB, has 250 books and 64 journal subscriptions. The collection at the Operations Training Division, Williams AFB, includes 456 books and 41 journal subscriptions.



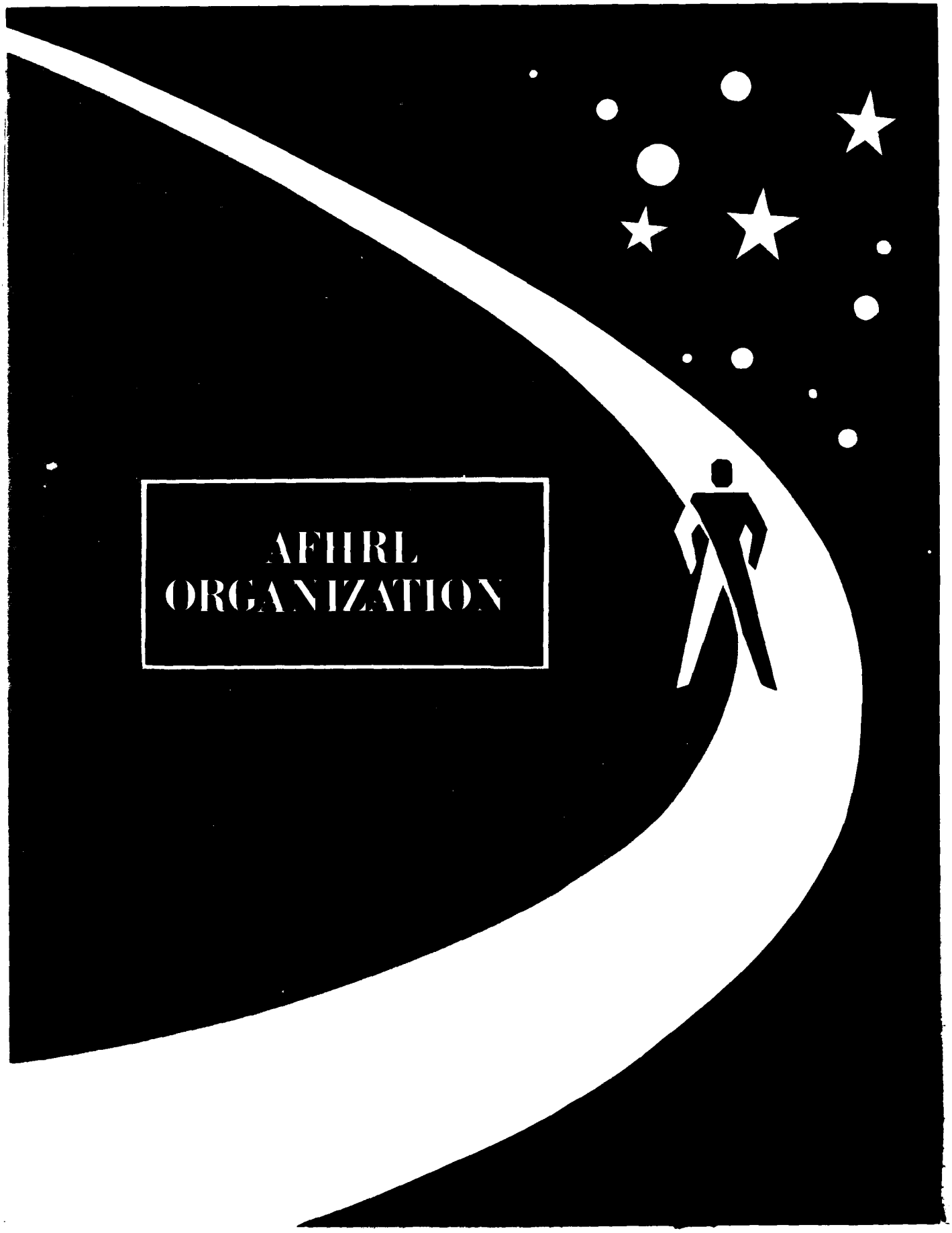
LOC Data Base Management

Office automation within AFHRL is currently supported by a Wang Laboratories VS-80 computer. This equipment provides an automated word processing capability, as well as electronic mail service among AFHRL Wang users. Computer terminals and printers located throughout AFHRL allow users to create, edit, revise, and print correspondence. In the past, these functions normally were done with typewriters. These devices greatly increase the ease and efficiency with which this correspondence is handled. In addition, all correspondence is filed on magnetic disks for later retrieval and use as needed, or for deletion when no longer required. The electronic mail feature allows transmission of correspondence to and from any of the AFHRL divisions. At preset times during the work day, long distance telephone calls are automatically made to each remote location and any mail items are distributed. Mail items from the remote locations are also picked up at those times and delivered to the proper recipient, whether at Brooks AFB or at another remote location. Urgent correspondence is handled on a priority basis, with delivery to the receiving system generally occurring within 15 minutes. These features of the office automation system greatly reduce the paperwork burden of AFHRL personnel in accordance with the Paperwork Reduction Act of 1980 (PL-96-511) and streamline the many administrative tasks necessary in today's offices.

AFHRL
GEOGRAPHICAL LOCATIONS

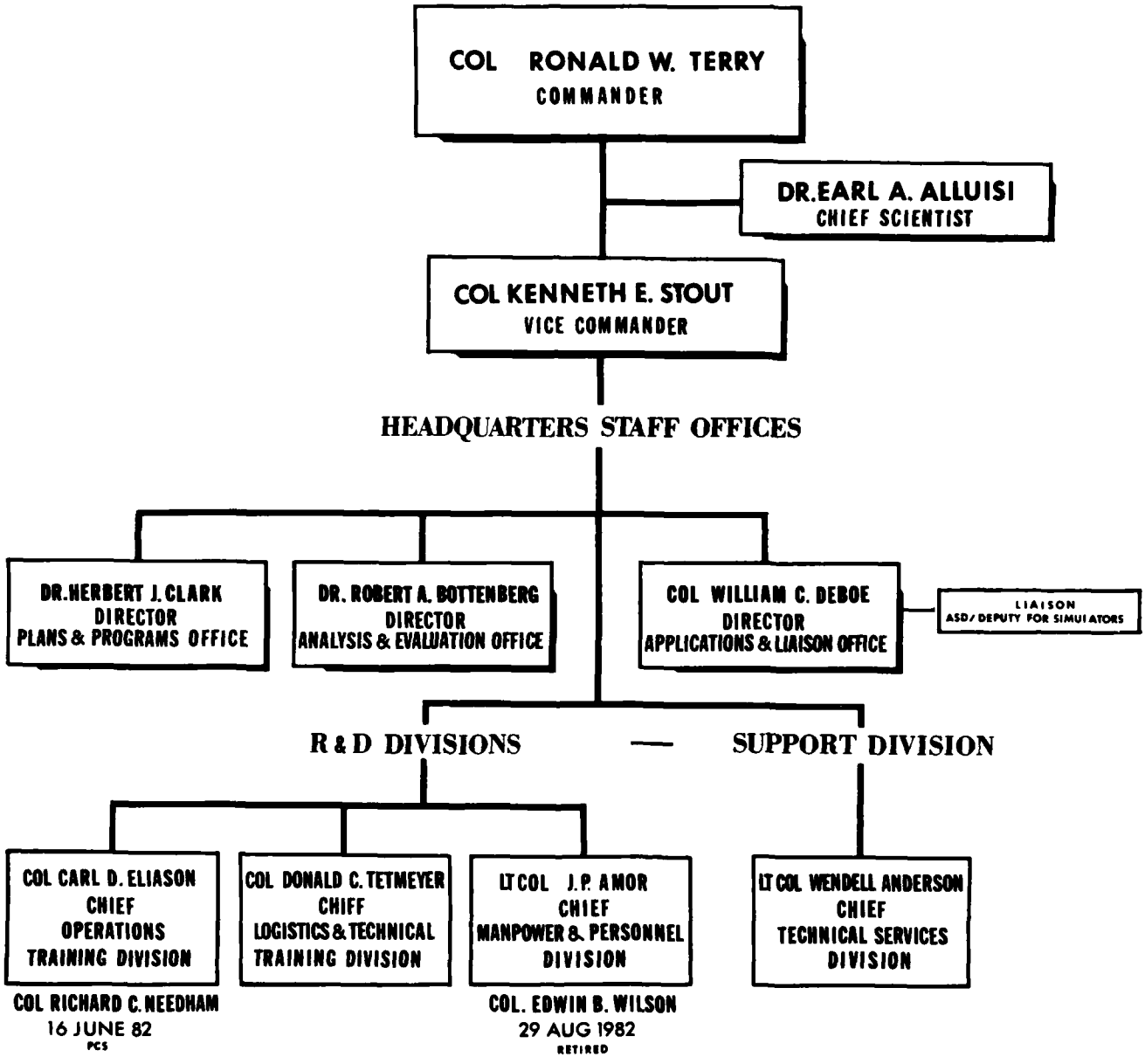


The above map depicts the geographical locations of the AFHRL divisions and activities. The Logistics and Technical Training Division and its Logistics Research Branch are collocated at Wright-Patterson AFB, Ohio, with relevant user commands such as the Air Force Logistics Command, the Aeronautical Systems Division, the Aerospace Medical Research Laboratory, the Air Force Wright Aeronautical Laboratories, the Air Force Acquisition Logistics Division, and the Simulator Systems Program Office. The Technical Training Branch is collocated at Lowry AFB, Colorado, with Air Training Command's (ATC) Lowry Technical Training Center. The Operations Training Division is collocated at Williams AFB, Arizona, with an ATC undergraduate pilot training wing and with a Tactical Fighter Wing at nearby Luke AFB. In San Antonio, Texas, at Brooks AFB, the Manpower and Personnel Division is collocated with the Aerospace Medical Division and the USAF School of Aerospace Medicine. In close proximity is the Manpower and Personnel Center and Headquarters, Air Training Command, at Randolph AFB. The Air Force Military Training Center is located nearby at Lackland AFB. The Technical Services Division, also at Brooks AFB, supports the AFHRL scientific and technical programs.


AFHRL
ORGANIZATION

AIR FORCE HUMAN RESOURCES LABORATORY

ORGANIZATION



VICE COMMANDER

Colonel Kenneth E. Stout

The Vice Commander assists the Commander in the performance of his command function and commands the Laboratory during absences of the Commander. The Vice Commander chairs the Laboratory's Corporate Planning Group (CPG) and the Corporate Planning Group Executive Committee (CPGEC).

The Corporate Planning Group is responsible to the Commander for recommendations and priority assignments on laboratory policy, short- and long-term goals, and overall mission and thrust alternatives. The CPG consists of the Vice Commander, the Chief Scientist, the Directors of Headquarters Staff Offices, the Division Chiefs, and the Executive Officer (Recorder). The CPG meets at least once annually.

The Corporate Planning Group Executive Committee consists of the Vice Commander, the Chief Scientist, the Directors of Headquarters Staff Offices and the Executive Officer (Recorder). The CPGEC acts for the CPG between CPG meetings, and meets at least once monthly.

Normal functions of the CPGEC are the following:

a. Upon the Commander's approval, the committee disseminates policy or guidelines to, or requests reports or information from, any AFHRL organization element or other offices and agencies.

b. The committee reviews the Technical Advisory Board recommendations regarding the Laboratory's RDT&E program for compliance with policy, goals, objectives, and priorities.

c. CPGEC forwards recommendations regarding the RDT&E program to the Commander, with comment.

d. Upon the Commander's approval, the CPG Executive Committee forwards the Commander's Approved RDT&E Program to the operating RDT&E Divisions and Headquarters Staff Offices through the Plans and Programs Office.

e. Finally, the committee makes recommendations to the Commander for assignments of Divisional and Headquarters Staff Office responsibilities and added efforts, including new technical thrusts.

PLANS AND PROGRAMS OFFICE

Dr. Herbert J. Clark
Director

The Plans and Programs Office plans, implements, and manages the conduct of the AFHRL Research, Development, Test and Evaluation (RDT&E) program. Staff members perform long-range planning that combines higher headquarters guidance, Air Force user requirements, and technological opportunities. This office publishes all planning documents and prepares budget submissions to higher headquarters. The Plans and Programs Office effects program implementation by processing financial and budgetary documents and monitors the progress of all support, contractual, and in-house RDT&E efforts. The office provides the resource management required to execute effectively the RDT&E program.

The Director of Plans and Programs is responsible to the AFHRL Commander for the proper operation of the Plans and Programs Office and bears staff responsibility for the Laboratory Headquarters' mission in plans and documentation, operations, programs, and financial management. The Director serves as a member of the Corporate Planning Group and the Corporate Planning Group Executive Committee.

ANALYSIS AND EVALUATION OFFICE

Dr. Robert A. Bottenberg
Director

The Analysis and Evaluation Office at AFHRL is responsible for the planning and execution of studies to evaluate potential benefits and costs for major AFHRL Research, Development, Test, and Evaluation (RDT&E) programs. Through direct interaction with project managers and Air Force users, plans are identified for the development, testing, acquisition and deployment of products and systems. Studies conducted by this office provide the AFHRL Commander and the Plans and Programs Office with information concerning potential force multiplier effects and life-cycle benefits and costs which are anticipated from the investment of resources in major programs. The Analysis and Evaluation Office provides guidance to AFHRL Divisions in the development and estimation of research and development costs. Finally, the staff is responsible for the conduct of special studies which focus on Laboratory operations.

The Director of Analysis and Evaluation is responsible to the AFHRL Commander for the proper operation of the Office and bears staff responsibility for the Laboratory Headquarters' mission in analysis and evaluation of planned and on-going RDT&E. The Director also serves as a member of the Corporate Planning Group and the Corporate Planning Group Executive Committee.

APPLICATIONS AND LIAISON OFFICE

Colonel William C. DeBoe
Director

The Applications and Liaison Office is responsible for promoting the transfer of R&D end products to the operational community, for assessing the use of these products, and for fostering closer coordination between researchers and user organizations. The office has developed processes which monitor, evaluate, and provide AFHRL managers with feedback on the utilization of completed R&D.

This office is charged also with fulfilling the requirements of the Stevenson-Wydler Technology Innovation Act of 1980 which mandates that Federal research agencies disseminate the results of their R&D to state and local governments and to the private sector. To carry out this function of wider technology transfer, an Office of Research and Technology Applications has been established within AZ.

The Applications and Liaison staff manages the Independent Research and Development (IR&D) program for AFHRL. Through this program scientists and engineers evaluate the research and development projects of private industry that have a potential application to a military function or operation. Personnel of this office review the technical plans submitted by commercial firms, solicit and summarize external evaluations and coordinate on-site technical reviews of IR&D performed at AFHRL designated firms. The results of technical evaluations are used in the determination of negotiation objectives for IR&D advance agreements. In FY82 AFHRL evaluated over 230 projects worth 62.6 million dollars.

Finally, the office publicizes the Laboratory R&D program through the Air Force Report on the Utilization of People-Related RDT&E, the Annual Report, the Quarterly Newsletter, informational flyers and brochures.

The Director is responsible to the Laboratory Commander for the proper operation of the office and bears staff responsibility for the Laboratory Headquarters' mission in RDT&E applications and liaison. He serves as a member of the Corporate Planning Group and the Corporate Planning Group Executive Committee.

Dr. Robert A. Bottenberg
Director

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HEADQUARTERS
STAFF PERSONNEL

Colonel Richard C. Needham
16 Jun 82 PCS

Colonel Carl D. Eliason
Division Chief

Responsibility for research and development in flying training technology for the Air Force Human Resources Laboratory resides with the Operations Training Division. This Division develops, tests and evaluates existing and newly developed hardware, programs, procedures, and techniques for improving all phases of flying training programs. The Division is collocated with the Air Training Command (ATC) at Williams AFB, Arizona, and works closely with the Tactical Air Command (TAC), Luke AFB. The Division facilties are accessible to the Air Force flying commands (ATC, TAC, Military Airlift Command, and Strategic Air Command) and serve the Navy and Army as well. The close proximity to the Luke Instrumented Air Combat Maneuvering Range, Tactical Fighter Weapons Center, and Air Force Flight Test Center enhances its interface with the operational community.

The thrust of the Operations Training Divisions's activities is oriented toward air combat tactics and training. Four major subthrusts are involved: engineering simulation technology, developing the combat mission trainer, air combat training research, and research and development in operational unit training systems.

The Advanced Simulator for Pilot Training (ASPT) simulates A-10 and F-16 aircraft. This capability enables the Division to conduct research in a broad spectrum of areas of interest to the tactical fighter community. These include defining simulation equipment and techniques which may lead to improved training transfer and better operational simulators. In addition, since the simulator is configured with front line fighter/attack aircraft, additional research in evaluating the utility of future aircraft modifications and unique sensor components can be conducted.

The Division is conducting research in flying skills maintenance and reacquisition, low-level navigation, air-to-air refueling requirements, air combat maneuvering, air-to-ground continuation training, operational test and evaluation, and A-10 and F-16 syllabus development. Research efforts also include simulator visual and force cue requirements and development of advanced simulator hardware systems. The combat mission trainer concept utilizes fiber optics and helmet-mounted displays packages in a transportable system that will provide tactical training at the squadron level. The Division is currently engaged in the development of special function trainers using video-disc and microprocessor technology which will provide part-task training in a wide variety of settings.

The Division has initiated research efforts to investigate pilot performance in simulated hostile high-threat environments. Research efforts to date include determining pilot performance in hostile situations, impacts of programmed threat proficiency, chaff, and Electronic Countermeasures protection. Refinement of these simulation efforts will have a major impact on increasing Air Force readiness by improving training for hostile flight regimes in the high-threat environment.

Dr. Milton E. Wood
Technical Director


OPERATIONS
TRAINING
DIVISION

LOGISTICS AND TECHNICAL TRAINING DIVISION

Colonel Donald C. Tetmeyer
Division Chief

The prime objective of this Division's thrust is to provide the technology to ensure effective and efficient support of Air Force operations. This support includes planning and management of both material and human resources. Special attention is devoted to maintenance. Also included as an objective is the technology to ensure effective team performance in ground-based systems. The area consists of three interrelated subthrusts: (a) Combat Logistics; (b) Technical and Maintenance Training; and (c) Crew, Group, Team, and Unit Performance and Training.

The first subthrust pertains especially to the logistics aspects of Air Force weapon systems. It includes technology to improve maintenance diagnostics technology for integrated logistics support of weapon systems, improved techniques for planning maintenance and logistics for combat environments, and technology for automating logistics elements such as technical data.

The second subthrust pertains to technical training, with special attention to training maintenance personnel. A new system is being developed for job-site training and proficiency certification. Work is continuing in technology for maintenance simulation and in transitioning developed technology for computer-based instruction to extensive use in the Air Force.

The third subthrust is aimed at improving the performance of non-flying crews, groups, teams and units. Special attention is being given to teams involved in command, control, and communications systems because of the pressing current needs for improvements in those systems.

R&D investment in the area of these subthrusts promises unusually high payoff. The potential to reduce cost and increase weapon system supportability is high because this area of technology is quite underdeveloped and initial big-step improvements can be made. The subthrusts have been the subject of unusual high-level interest. Special scientific and operational study groups have stressed the need for increased R&D in the subthrust areas.

Lt Col Joseph A. Birt
Technical Director


LOGISTICS
AND
TECHNICAL
TRAINING
DIVISION

MANPOWER AND PERSONNEL DIVISION

Colonel Edwin B. Wilson
29 Aug 82
Retired

Lt Col J. P. Amor
Division Chief

In 1982, General Gabriel, Air Force Chief of Staff, stated before the Senate Armed Services Committee that "Attracting and retaining the right numbers and sufficient quality of skilled and motivated people is the principal challenge for the Air Force." To help the Air Force meet this objective, the Manpower and Personnel Division of AFHRL has a research program designed to improve ways to attract the most qualified individuals, optimally assign them where they will be the most productive, and retain a sufficient number in the career force to meet operational requirements.

To support the Division's major thrust, i.e., manpower and force management, R&D is conducted to develop management tools, procedures and associated technologies to improve procurement, selection, classification, utilization, productivity, and retention of Air Force personnel. Results of this research provide a substantive basis for personnel decisions in all phases of the military life cycle to maximize the utilization of talent and to ensure that manpower resources are allocated to maximize the return on personnel investment.

Matching the right person with the right job requires job analysis and individual qualification assessment. The capability to assess an individual's aptitudes, interests, experience and educational background, depends on an on-going R&D program to develop and refine the personnel measurement techniques. As for the job component side, on-going projects include methods for collecting and analyzing occupational information and the establishment of entry level requirements in terms of aptitude, basic skills, physical strength and stamina, experience, and education. The Division also manages the research and development requirements in support of the tri-service operational testing program - the Armed Services Vocational Aptitude Battery.

New research and development efforts focus on the development of analytical tools for efficient management of manpower resources and the identification and forecasting of personnel problems. Computer-based models for skill requirement projections, retention analyses, training decisions and assignment/reassignment actions are being developed. They will update and fill critical gaps in the characterization of the manpower, personnel and training system and will provide a firmer basis for informed policies and effective management decisions.

In order to maintain sufficient quantity and quality of personnel in the career force, the Manpower and Personnel Division is also conducting studies to *improve personnel utilization, job satisfaction,* productivity, workgroup effectiveness, and career motivation. In addition, preliminary planning of a series of R&D efforts has been initiated to develop on-the-job measures of individual performance . Such measures will provide the legally mandated criterion measures to validate the on-going selection, classification, and training programs in the Air Force.

Dr. Nancy Guinn
Technical Director

MANPOWER AND PERSONNEL DIVISION

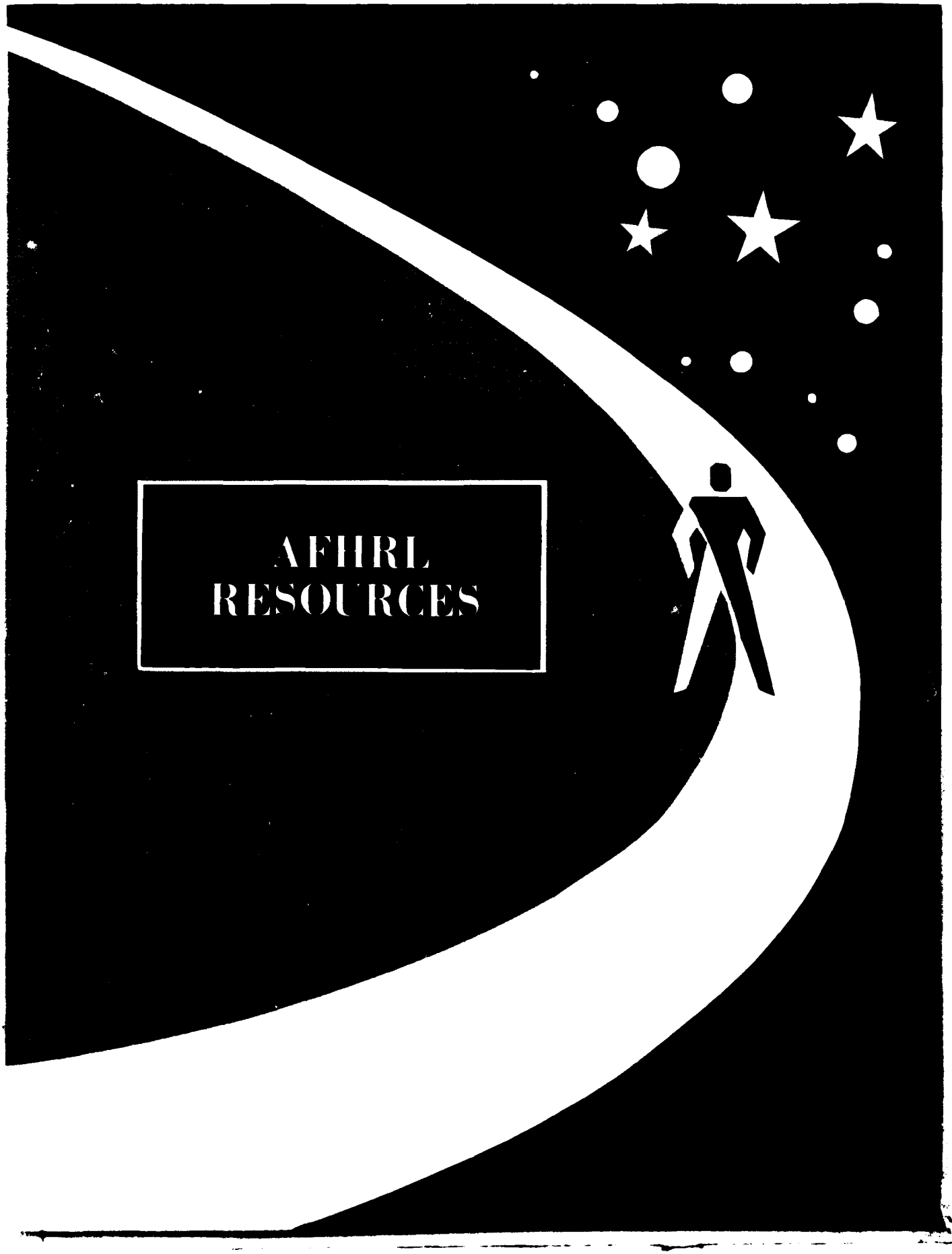
Lt Col Wendell L. Anderson

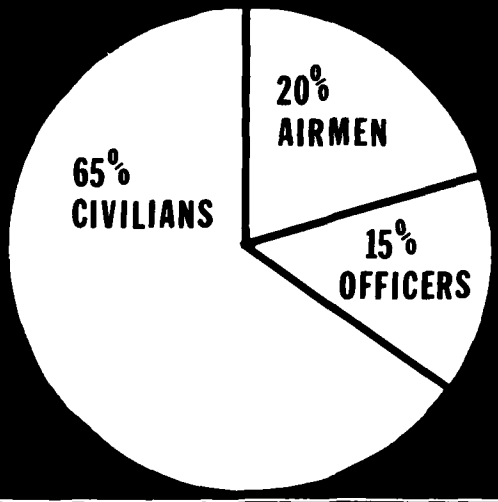
The Technical Services Division plans, allocates, and controls facility and manpower resources. The Division directs the scientific and technical information program, including the technical library, to meet the information needs of scientific and technical personnel in managing, monitoring, and conducting Research and Development (R&D). Further, the Division provides a full range of technical editorial services, plans and directs the recording of the corporate history, provides staff administrative services, and serves as the focal point with supporting organizations. The Division develops data bases, maintains data files, and operates the computer system to support the Research, Development, Test, and Evaluation activities of the Laboratory; and provides project analysis and computer programming support to the other Divisions of the Air Force Human Resources Laboratory.

The Chief of the Technical Services Division is responsible to the Laboratory Commander for the proper operation of the Division and serves as a member of the Corporate Planning Group and the Corporate Planning Group Executive Committee.

The organizational elements within the Technical Services Division are the Technical Editing Office, Scientific and Technical Information Office, Executive Support Branch, Computer Operations Branch , Computer Programming Branch, and Management Information Center.


TECHNICAL
SERVICES
DIVISION


AFHRL
RESOURCES

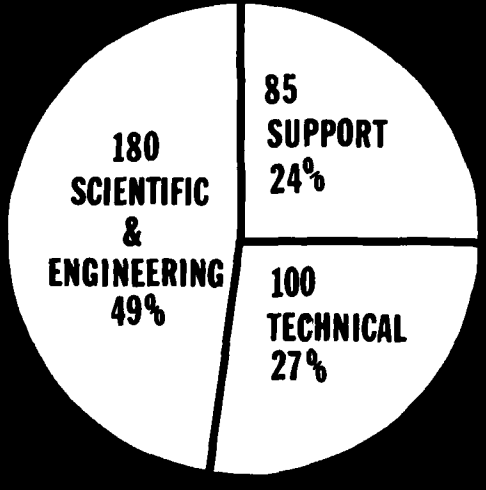


DISTRIBUTION OF AUTHORIZED PERSONNEL FY 82

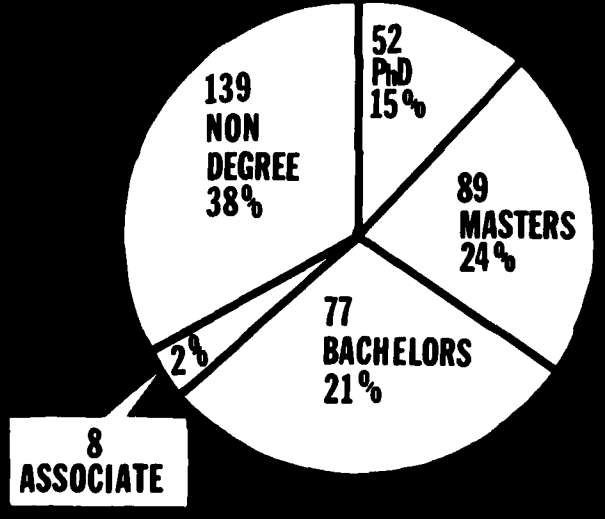
DIVISION	
MANPOWER & PERSONNEL	77
LOGISTICS & TECHNICAL TNG.	82
OPERATIONS & TRAINING	67
TECHNICAL SERVICES	104
HEADQUARTERS	35
TOTAL	365

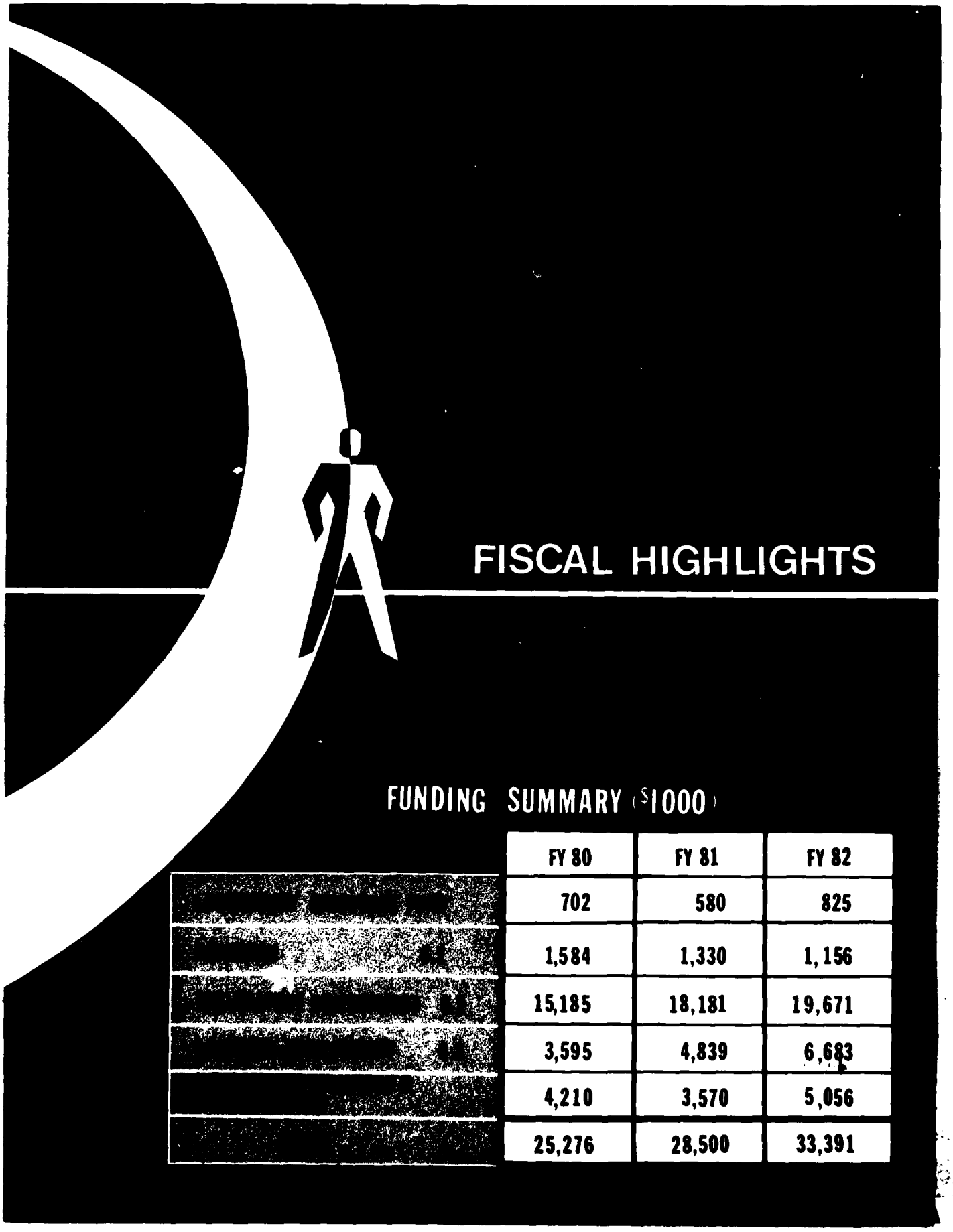
CLASSIFICATION	
OFFICERS	57
AIRMEN	72
CIVILIANS	236
TOTAL	365

PERSONNEL TYPE



ACADEMIC DEGREES





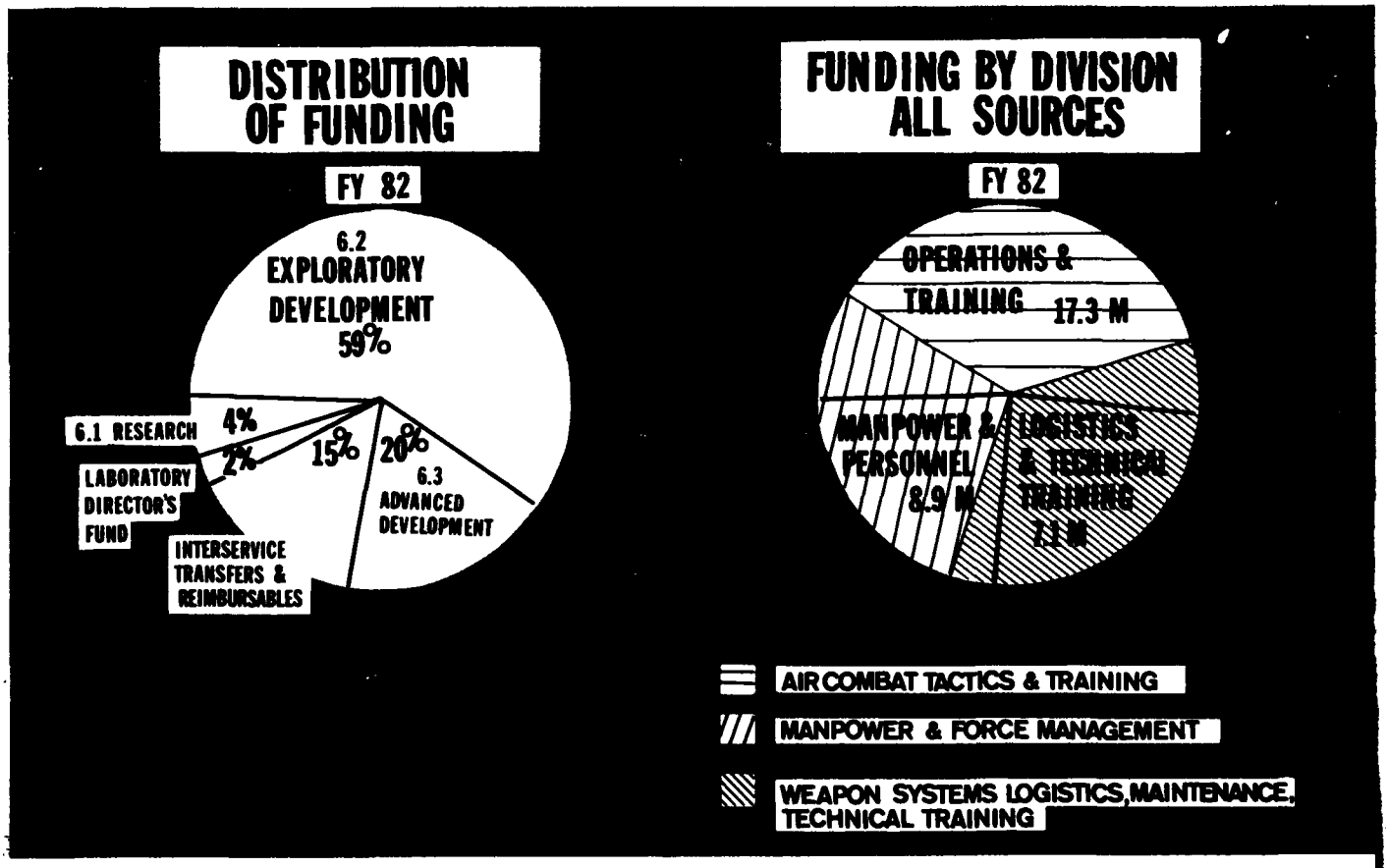
FISCAL HIGHLIGHTS

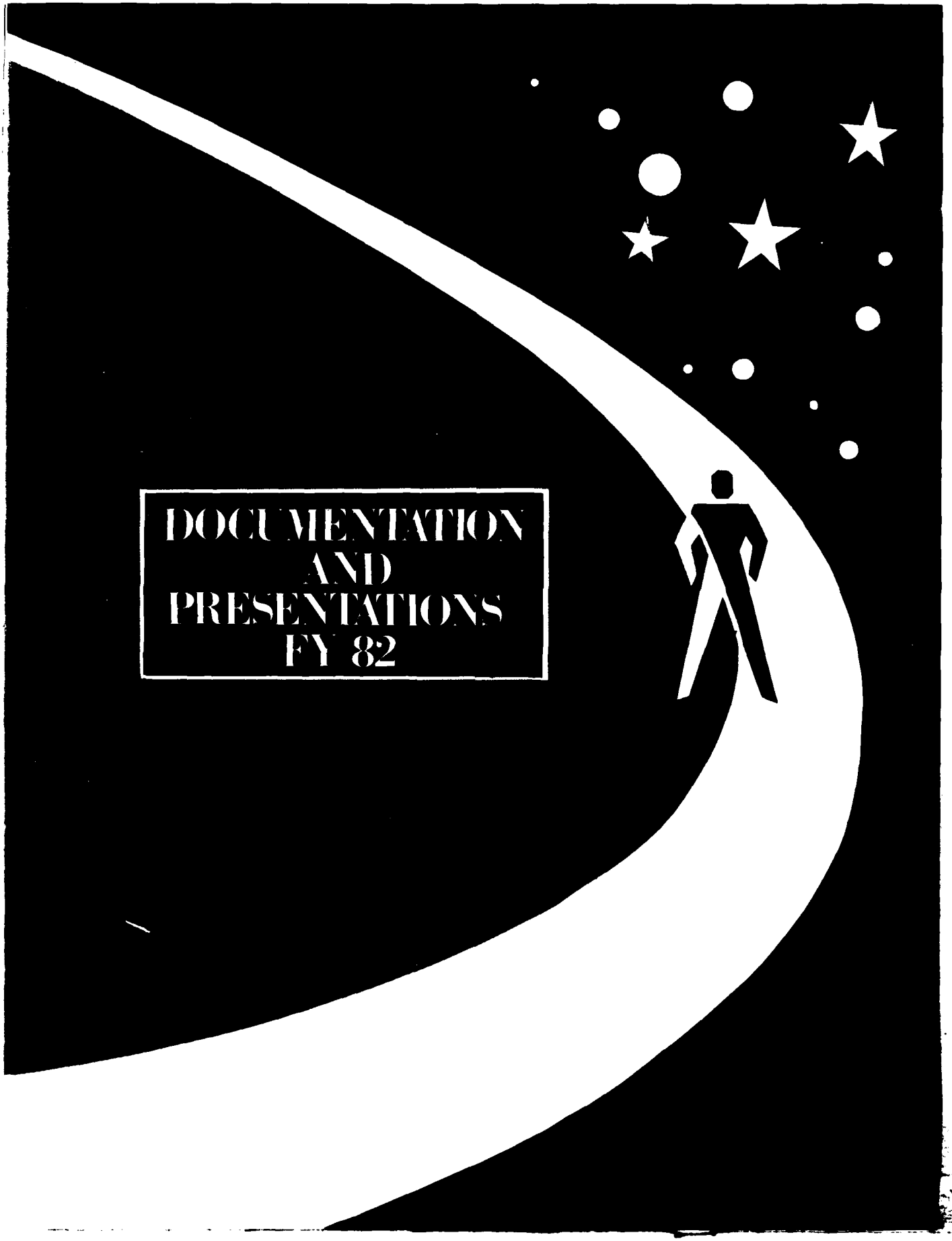
FUNDING SUMMARY ($1000)

	FY 80	FY 81	FY 82
[redacted]	702	580	825
[redacted]	1,584	1,330	1,156
[redacted]	15,185	18,181	19,671
[redacted]	3,595	4,839	6,683
[redacted]	4,210	3,570	5,056
[redacted]	25,276	28,500	33,391

INVESTMENT STRATEGY

The goal of AFHRL's R&D program is to ensure combat success by optimizing human performance. This emphasis on personnel is based upon a growing awareness that complex systems require extremely well-trained personnel to support, operate, and maintain them. To achieve the optimization of human performance, AFHRL is investing its resources in an R&D program to develop the technology to acquire and manage the highest caliber personnel force possible, and to train this force to use and maintain sophisticated weapons systems. Technologies which appear to have order-of-magnitude implications for force effectiveness will be vigorously sought out and resources applied to such efforts. Attention will also be given to affordability considerations of technology products in the development of our investment strategy. It is AFHRL policy to apply its available resources to projects and programs which have been requested by and coordinated with customers who are ultimately responsible for implementing technology development. It is also AFHRL policy to invest a significant fraction of its discretionary resources in the development of a research and technology base which is not contingent upon the prior coordination of potential users. Within this group of investments, it is AFHRL policy to set aside some resources for projects which would not otherwise be supported. This approach is based on the observation that some of the most significant and far-reaching results of research and development have come from scientific efforts which were neither supported nor considered feasible within the scientific environment of the time. The potential for dramatic improvements in force effectiveness justifies the investment of resources in a limited number of such projects.




DOCUMENTATION
AND
PRESENTATIONS
FY 82

AFHRL PUBLICATIONS

AFHRL publishes Technical Reports (TRs), Special Reports (SRs), and Technical Papers (TPs). All three kinds of reporting documents are available at the Defense Technical Information Center for qualified users and at the National Technical Information Service for the general public. These documents are announced in the Technical Abstract Bulletin and the Government Reports Announcements and Indexes published by the two organizations, respectively. They are also announced in the annual AFHRL bibliographies.

Technical Reports are the documented results of Department of Defense sponsored research, development, test, and evaluation projects. The purpose of the Technical Report is to communicate information generated as part of the these projects.

The Technical Paper, like the Technical Report, is directed more toward the research and development community than is the Special Report but, in general, is less rigorous than is a Technical Report. While a Technical Paper may be of extreme value to some researchers, it may not have the wide audience that a Technical Report does. Some examples might be professional papers, briefings, technical memos, bulletins, notes or working papers having permanent value, memoranda of lessons learned, computer documentation, and concept papers. The intent is to preserve information that has long-term value but that, due to its limited audience, may not justify the costly and time-consuming processing requirements that the usual TR entails.

The Special Report is specifically directed toward users of research and development findings and contain recommendations for implementation based on these findings. Such a report is issued on completion of work in response to a Request for Personnel Research, Technology Need, or Logistics Need but may also be issued at other times when management deems it appropriate. The intent is to provide a report that is shorter than the usual TR, that speaks in non-technical language, and that emphasizes results and applications; i.e., what AFHRL has found that will help the user solve current or anticipated problems.

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2– 3 March 1982	Workshop on Maintenance Diagnostics Errors, Wright-Patterson AFB OH
10–11 March 1982	Laboratory Information Resource Management Working Group Meeting, Brooks AFB TX
4– 6 May 1982	National Security Industrial Association/Department of Defense, Conference on Personnel and Training Factors in Systems Effectiveness, San Antonio TX
14–18 June 1982	Generalized Goal Programming Seminar, Brooks AFB TX
15 June 1982	Computer Adaptive Testing Interservice Coordinating Committee, Brooks AFB TX
16–18 June 1982	ASVAB Working Group, Brooks AFB TX
28–29 September 1982	Joint Services Job Performance Measurement Conference Brooks AFB TX

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